

August 19, 1963

Aviation Week & Space Technology

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A McGraw-Hill Publication

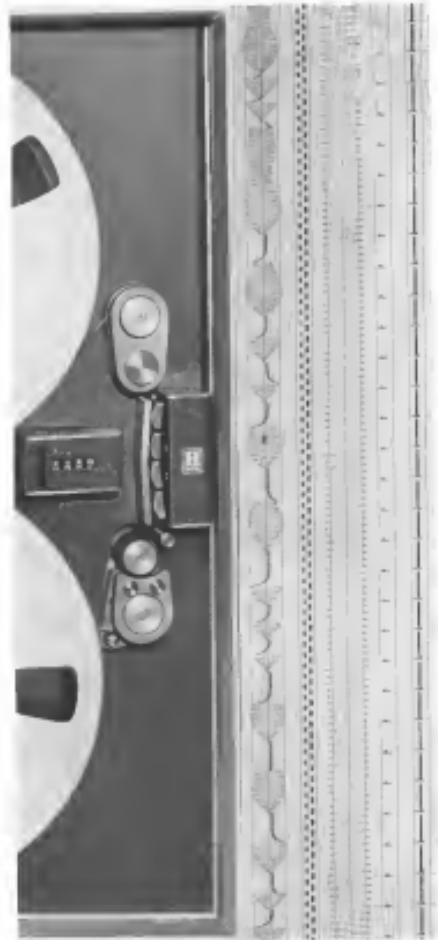
NAA Studies
6-Man Logistics
Spacecraft

Radar Telescope Construction
At Arecibo, Puerto Rico



SPECIAL REPORT:

Gemini Environmental Control System



NOW and/or LATER

To get the most out of analog data, you should be able to use it now or store it for use later, now or later. The ideal combination of recording instruments for making the most of your analog data is a Honeywell tape recorder such as the compact Honeywell 8100, and a Honeywell tape recorder/reproducer, used with the Honeywell Vicksor Oscillograph.

For immediate readout, the Vicksor recorder gives up to 6 channels of data from 100 to 1,000 cycles per second. A variety of paper speeds from 1 to 360 inches per second gives you maximum choice when you need it. Five models of the Vicksor are available.

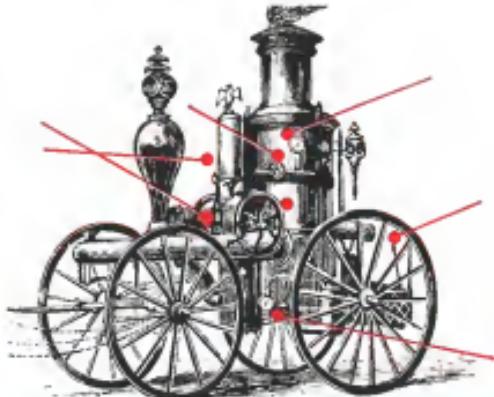
At the same time, you can record up to eight channels (plus voice and compensation) of data up to 10,000 cycles per second. With the Vicksor recorder, you can play selected portions of your data into the Vicksor Paper tape speeder (176, 375, 75, and 18.75 inches per second) giving you maximum choice when you need it. Four models of the Vicksor are available.

In the Honeywell 8100, several broad and true road positions were considered (HRC). All models have a built-in control panel, continuous switching of output frequencies, and a new, improved tape position that cuts down to a minimum the number of tape changes. A built-in monitor scope and voice channel are optional. In addition, Honeywell microphones, tape recorders, and magnetic tape recorders with capacities of up to 60 channels on 1/4-inch tape.

For complete information about the Honeywell 8100, the Vicksor Oscillograph, and other recording equipment, contact your nearest Honeywell office, or write: Honeywell, Denver Division, Denver 16, Colo. Or call us direct at 303/791-4311. In Canada, contact Honeywell Controls, Ltd., Etobicoke 17, Ontario.

DATA HANDLING SYSTEMS

Honeywell



FORERUNNER OF REACTION CONTROLS?

Wondering what this ancient pump has to do with reaction controls for aerospace applications? They're both based on the science of fluid dynamics.

Vickers' business for more than 40 years with aerospace and aerospace applications, going back to the early '40s.

Current projects under study or development at Vickers Aerospace include: missile velocity correction and reaction steering; attitude control systems and gyroscopes; solid propellant rocket attitude control systems and components; and proportional hot gas secondary engines.

For any of these activities, the program manager has at his disposal the specialized skills, experience and facilities available only at Vickers. Groups of specialists in aerothermodynamics, fluid flow, sound, stress, vibration, instrumentation, systems analysis,

valve development, materials and processes provide added insurance of success in obtaining all the program's goals.



Vickers Aerospace designs & develops 30-pound-class reaction control for the Space Shuttle orbiter (right). Pneumatic vehicle control valves and proportional servomechanisms developed with Air Reduction's 10000 "Reaction Plates for Aerostatic Valves" in Vicksburg, Mississippi. P.O. Box 202, Vicksburg, Michigan.





During the past four years this computer has successfully guided 133 consecutive missiles and satellites and has yet to be charged with a single countdown hold.

Quick! What company makes it?

If you know electronic data processing, you know the answer: UNIVAC.

The UNIVAC system referred to is called "ATHENA". It was the first completely transistorized computer ever delivered—back in May 1957. And it has performed reliably ever since. In fact, its comparable devices in our nation's space and missile projects can come close to equaling its performance record: reliability of ATHENA is 3500 hours between failures, nearly a half year of continuous operation.

UNIVAC'S ATHENA has inserted Echo, Explorer, Tiros, OSO, Agena, Telstar, Relay and Syncom satellites into orbit from both Cape Canaveral and Vandenberg Air Force Base. Today there are UNIVAC ground guid-

ance systems at all Titan I missile sites. A special Air Force plaque honors UNIVAC for "outstanding efforts and significant contribution to the TITAN ICBM Program."

Unusual? Uncommon? Not if you know UNIVAC.

From the yesterday of ENIAC and BINAC, to the fluid mechanics, microelectronics and thin-film magnetic memories of today, UNIVAC has made most of the industry's major technical advances. UNIVAC offers a quick response to every demand... outstanding scientific and engineering talent... total systems programming and management capability. Can this demonstrated competence speak for you? Write... call UNIVAC.

THE DIVISION OF SECURITY INFORMATION

AEROSPACE CALENDAR

- Aug 25-26—Midwesters for Aerospace Flight Conference, American Institute of Astronautics and Astronauts, Doubletree Hilton Hotel, Columbus, Ohio

Aug 26-28—Conference on Physics of Entry into Earth's Atmosphere, American Institute of Astronautics and Astronauts, Massachusetts Institute of Technology, Cambridge, Mass.

Aug 27-29—National Conference and Information Data Exchange Exhibit, Ann Arbor, Mich., Mayberry, Dearborn Hills Inn, Dearborn, Mich.

Sept. 4—Memorial Control Workshop Session, Cleveland Club, Cognacine American Society of Test and Measurement Engineers, Indianapolis, Indiana, Indianapolis, Ind.

Sept. 10-12—International Symposium on High-Temperature Technology, Aradano, Calif. Sponsored by Stanford Research Inst.

Sept. 11-14—Annual Meeting, An International Association of Canada, Marquette Recherche, Marquette, Quebec, Canada

Sept. 12-14—Annual Standardization Conference, University of Connecticut, Storrs, Conn.

Sept. 14-17—Seventh National Convention on Military Electronics, Institute of Electrical and Electronics Engineers, Hyatt Regency Hotel, Washington, D.C.

Sept. 19-22—10th Annual International Antenna and Propagation Conference & Exhibit, Instrumentation Park, Ga.

(Continued on page T)

**Engineers
and
statisticians
take
note:**



This calculator squares numbers and extracts square roots automatically

And it's the only desk calculator in the world that does the Frden 880's Calculations.

To square a number, simply enter it on the keyboard, and touch one key. The answer appears in the upper disk.

To extract a square root, simply enter the number on the keyboard, and touch one key. Your answer then appears to the lowest digit.

These exclusive features, plus Fodin fully automatic division and touch-one-key multiplication, free you for instant tasks. The

Under fully automatic Calculator performs more flypaper work stops automatically than any other desk calculator ever made.

No comment or statement should

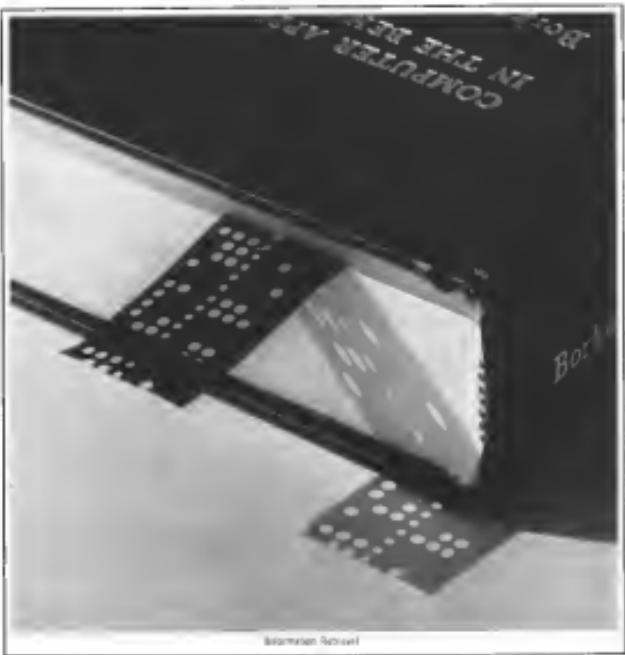
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Information Retrieved

Instant Bookmark

The technology of information retrieval is one of the major concerns of SDC. For some time, our SDC systems (real-time electronic broadcast information retrieval) has been capable of quickly presenting, at widely separated SDC facilities, desired technical documents and outside sources. SDC can be operated by remote control, the only such system that can be so operated. A full sensor SDC development is now underway. In which it is a phase of SDC, our long-range project to teach computers to read and work with data. Prototype is now in, firm assembly, to fine single paragraphs within the complete text of an article or document. Since will cause the ability to extract individual sentences and facts. As SDC continues to make noteworthy progress in many areas of information systems technology, a number of new

parties have been created on several of these major projects. These factors, scientists, operations research scientists, space-oriented engineers, and computer programmers interested in applying their rapidly expanding technology are invited to write Mr. A. E. Graville, Jr., SDC, 5410 Calleste Avenue, Santa Monica, California. Positions are open at RDC facilities in Santa Monica, Washington, D.C., Lexington, Massachusetts, Princeton, New Jersey, and Dayton, Ohio. An SDC brochure on information retrieval also is available. Requests for free new brochure should be sent to Mr. Graville at Santa Monica. "An equal opportunity employer."

Systech Development Corporation



81-003

AEROSPACE CALENDAR

(Continued from page 5)

Society of America, McCormick Place, Chicago, IL
Sept. 9-11—International Conference on Firestone Engineering Research, Carnegie Institute of Technology and Whistler Hall Hotel, Pittsburgh, Pa.
Sept. 10-12—National Symposium on Space Radiators, Russia and America, Ed work AFB, Calif. Sponsored American Astronautical Society, Air Force Flight Test Center.
Sept. 10-12—New York University's Third Annual Air Transport Conference, Washington Square Center, New York, N.Y.
Sept. 11-13—17th Annual National Convention of Aerospace Engineers At Forest Service Park, Silver Spring, Maryland, Washington, D.C.
Sept. 14-15—International Aviation Research and Development Symposium, Atlantic City, N.J. Sponsored FAA.
Sept. 14-16—Annual Symposium on Microelectronics, Princeton, N.J.
Sept. 19-20—The 4th Annual Conference on Encapsulated Electros on Aircraft Systems, U.S. Naval Air Warfare Test Station, Trenton, N.J.
Sept. 20-21—11th Annual Conference on Components and Measurements, Institute of Electrical and Electronics Engineers, Hotel Roosevelt, Cedar Rapids, Iowa.
Sept. 20-22—Ninth Annual Houston Inter-Industry Trade & Supplier Fair, San Jacinto Coliseum, Houston.

Sept. 23-25—Symposium on Acoustical and Dynamic Modelling Technology, Bellman Hilton Hotel, Dayton, Ohio. Sponsored Air Force Systems Command's Acoustics Division, AFSC, Wright-Patterson AFB, Ohio.
Sept. 23-27—National Aerospace and Space Engineering and Manufacturing Meeting and Display, Society of Automotive Engineers, Ambassador Hotel, Los Angeles.
Sept. 23-25—International Telecommunications Conference, Savoy Plaza, London, Eng. Host Society, Institute of Electrical Engineers (London), Associate Institute of Aerodynamics and Acoustics, Institute of Electrical and Electronics Engineers, Instrument Society of America.
Sept. 24-26—19th Annual Convocation and Award Show, National Defense Aircraft Assoc., Shannon Hall Hotel, Houston.
Sept. 25-26—Second Annual Symposium on the Physics of Plasma in Electronics, Old capa, II. Sponsored Radio And Development Center, Assistant Research Foundation, DOD.

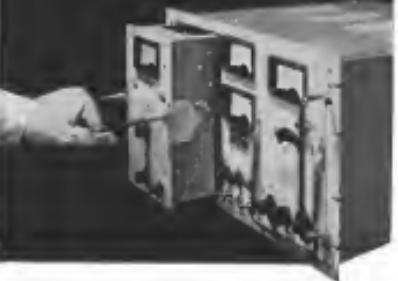
Sept. 26-Oct. 1-14th Congress, Intern. Assoc. Acoustical Federation, Paris.
Sept. 29-Oct. 3—Society of Experimental Test Pilot Society, Annual Meeting, The American Framingham and Arnold Hall, Sept. Beverly Hilton Hotel, Beverly Hills, Calif.
Sept. 30-Oct. 1—Marine Interdisciplinary Exploration Meeting, American Institute of Aerodynamics and Acoustics, Caltech Marine Sciences Institute, La Jolla, Calif.
Sept. 30-Oct. 2—Canadian Electronic Conference, Inst. of Electrical and Electronics Engs., Edgewater Park, Toronto.
Oct. 13-18—National Symposium on Space Electronics, Institute of Electrical Engineers, London, England.

AVIATION WEEK & SPACE TECHNOLOGY, August 18, 1978

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Versatile ... Proven ... Modular

VHF/UHF Telemetry Receiver



- Video Amplifier Response DC to 1 mc with Impedance Selectable 75 or 600 ohms
- AFC Optional on all IF Heads
- Multiple Bandwidth Front Panel Switchable IF Amplifiers
- Multi-Range Deviation Meter Calibrated Directly in KC

Immediately available from Defense Electronics, Inc. is the versatile, completely-modular TMR-5A telemetry receiver.

This reliable unit will currently accept 36 plug-in tuning heads ... 14 plug-in IF strips and six demodulators ... any one of which can be easily removed from the receiver in seconds! Additional heads, demodulators and IF amplifiers are available upon request.

Plug-in IF heads can be instantly inserted or removed from the receiver to provide the required frequency range by merely using the "single action" pull out handle.

The video driver also can be quickly converted by the various plug-in IF strips ranging from 3 KC to 24 MC, and plug-in demodulators for FM, AM, PM and PPM phase-lock applications.

The unit is particularly suitable for control scan, interim tracking, dual diversity combining and predetection record/playback applications.

Write for DEI bulletin TMR-5A ... or call:



Defense Electronics, Inc.

Main Office

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Phone: 305-639-0300

Fax: 305-639-0300

Reg. Mail Office: Sherman Oaks, Calif. Phone: 213-983-0300



All-weather flight management. Routine operation in any weather has long been the goal of aviation—and a prime engineering target at Sperry. We have devoted years to the problem—refining techniques, merging the technologies involved, closing the gap between Sperry systems for military and civil aircraft. (1) windshield projectors of flight and command data, with Beechcraft runway displays; (2) automatic pilots many times more reliable than current standards; (3) high-accuracy radio altimeters for automatic flare and landing; (4) electrostatic throttle and speed controls; (5) instrument and autopilot computer-monitors; (6) new two-axis Flight Director; for extended path and better world-standard General Controls and vertical motion systems. **SPERRY PHOENIX CO., Phoenix, Ariz.**

SPERRY
DIVISION OF
SPERRY RAND
CORPORATION

AEROSPACE CALENDAR

(Continued from page 71)

- and Electronic Engineers, Pennsylvania Hotel, Miami Beach, Fla.

Oct. 1-3—National Aerospace Nuclear Safety Topical Meeting, American Nuclear Society, Hotel Statler, Washington, D. C.

Oct. 1-3—Aerospace Operations Office, AF Space and Weapons Agency, AF Directorate of Nuclear Safety, India Creek, University City, Mo.

Oct. 4-5—Symposium on Physics and New Techniques, Testing (continued), San Antonio, Tex. Sponsored by Southwest Research Institute.

Oct. 4-6—Annual Meeting of Air Traffic Controllers Association, Oklahoma Hotel, Oklahoma City, Okla.

Oct. 7-9—8th National Communications Symposium, Institute of Electrical and Electronics Engineers, Hotel Tropicana, Las Vegas, Nev. U.S.A.

Oct. 7-9—International Air Transport Assn., 19th Annual General Meeting, Rome, Italy.

Oct. 8-10—6th Annual Air Force Science and Engineering Symposium, Air Force Academy, Colo. Sponsored by Office of Aerospace Research, AFSC.

Oct. 8-13—National Airport Conference, National Oil Spillers Association, Air of Oklahoma, with the cooperation of the Federal Aviation Administration, Oklahoma City, Okla.

Oct. 9-13—2nd Annual Aerospace Electrical/Electronics Conference, Aerospace Electrical Society, Inn Pacific Auditorium, Los Angeles, Calif.

Oct. 12-13—1965 General Conference, International Aeronomics International, New York, N.Y.

Oct. 13-17—High Altitude Meeting and Convention, American Council, Hotel New Haven, Los Angeles, Calif.

Oct. 14-18—National Conference and Symposium, Air Traffic Control Assn., Statler Hilton Hotel, Dallas, Tex.

Oct. 14-18—High Strength Symposium on Ballistic Missile and Space Technology, Naval Surface Warfare Center, Silver Spring, Md.

Oct. 14-18—Space Sciences Div., AF Ballistic Systems Div., Aerospace Corp.

Oct. 14-18—10th National Vibration Seminar, San Antonio, Valencia Inn, San Antonio, Texas.

Oct. 17-18—Div. 21-23—North American Conference, American Institute of Acoustics and Astronautics-Canadian Acoustics and Space Institute Royal Canadian Institute, Toronto, Ontario, Canada.

Oct. 18-19—Symposium on Solid State Devices, University, Cambridge, Mass. (Oct. 18-19) Grace Elizabeth Hotel, Worcester, Canada (Oct. 19-20).

Oct. 21-23—10th Annual Earth Conv. Conference, University of Michigan, Department of Geological Sciences, Institute of Earth and Planetary Sciences, The Foster Hotel, San Diego, Calif.

Hydraulic pressure control servo valve: for **high flow** with **low pressure drop**. Two stages. Modular design. Peak dynamic performance. **Precisely built.**



Several bidding rounds at approximately 20 Gt/M² (gross) attracted interest from both local and international buyers. Most of these bids were to bid private. Bidding prices indicate a significant interest level, with individual bidders, retail agents and auction houses.

This electrically operated dual hydraulic pressure control valve is used in Hydrex Aire's **Hydroflock** Mask. It has a three control system: it isolates the highly sensitive and continuous variation in brake pressure (from zero to full system pressure) required by Hydroflock; it isolates the pressure required to open the valve; and it achieves this variation rapidly and without step action. It is a five stage valve. The first stage first selected is a **precision torque limiter**. The actuator provides a pressure differential at the valve which is proportional to the current it receives. And this differential pressure output is essentially independent of flow magnitude. The electro-magnetic version of the first stage is isolated from the Hydraulic fluid, eliminating the need for magnetic filtration. A more powerful cartridge filter uses a sintered stainless steel sections to protect against contamination. Here is just one example of precise and advanced hydraulic system components built by Hydrex-Aire. In substantial quantities. We are qualified for this work as we are equipped for it. Whether you need a low pressure control valve or a very high pressure, extremely accurate hydraulic system, Hydrex-Aire can supply such valves—on time, better than you expect.

Hydro-Aire
Division of
CRANE



MICRO SWITCH Precision Switches

MIGHTY BIG FACTOR WHEN SWITCH RELIABILITY IS REALLY VITAL

The fact that MICRO SWITCH has had many years of experience in producing this sub-miniature switch can be a mighty important factor in the reliability of your products—important whether you specify this or any of the thousands of other switches made by MICRO SWITCH.

Mighty? Building high precision and reliability into such a small switch is one of the toughest jobs in the switch business. Yet this sub-miniature has enjoyed years of successful service throughout industry in applications where space and dependability are critical. You take full advantage of this experience and reputation when you specify my MICRO SWITCH switch in the equipment you make.

For details on MICRO SWITCH reliability control, write for the booklet, "Quality Assurance For Our Customers," or contact our Branch Office nearest you (See Other Pages).

153P Sub miniature Switch shown above. Size: .25" x .07" x .30". Rating: 7 amp., 110 or 230 vac.; 4 amps. Ind. load; 7amps. rms, 20 vdc.



MICRO SWITCH

FREESTPORT, ILLINOIS

A DIVISION OF HONEYWELL
If you have a question about Micro Switch products, call or write:



Reinforced plastics materials that turn 4000°F will continue the erosion of liquid chlorine threat during the thermal shock of reentry bodies is the principle business of U.S. Polymer Chemicals. Poly-Preg® pre-impregnated plastic reinforcement materials, filament winding resins, laminating stocks, molding compounds and tapes have contributed to the success of a host of aerospace projects. And, in concert with prime contractors, U.S. Polymer continues to develop materials that meet the formidable

requirements of avionics programs. Poly-Preg reinforcement materials include glass, vinyl, quartz, carbon, graphite, asbestos, Nylon, aromatic and others. Resin systems include phenolics, epoxies, polyesters, silicones, malamines and phenol chlorides. Manufacturer U.S. Polymer, as the leader in its field, is in the position to provide state-of-the-art materials, highly competitive prices, unmatched quality assurance and top technical assistance. Brief for Aerospace Materials delivery file #4.



Chemicals, Inc.

Poly-Preg

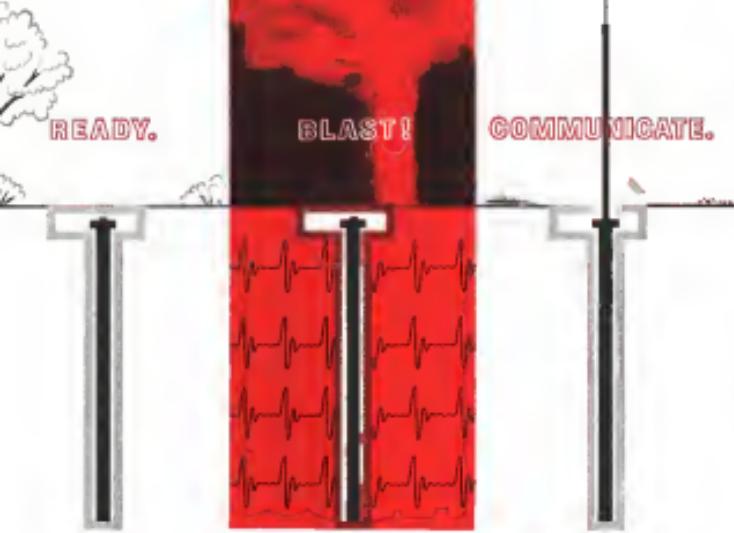
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Leader in research, development and supply of reinforced plastic prepreg materials for aerospace applications

■ new ideas in vibration/shock/space control



Shock system preserves post-attack reliability

Poled in underground silos, radio antennas are ready to pop-up for defensive post-attack communications to Titan III launch sites. But first, they must live through the attack. ■ Amongst survival is the job of special Lord shock mounting materials, engineered and produced for General Electric Company, system connector for Titan II communications. ■ Using both elastomeric mountings and steel springs, the system isolates the antenna from external blast effects. Attenuates vertical, radial and azimuthal shocks. Supports full antenna weight. Resists radiation. Protects so well that conventional commercial-grade electronic components can be used. ■ What's your vibration, shock or noise problem? Give us a challenge — then expect more. Contact: Lord Manufacturing Co., Eng. Fr. P.O. Box 2000, Engineering Office is principal office. In Canada: Railway & Power Engineering Corp., Ltd.

LORD



What new high speed tape transport means less down time?

AMPEX TM-5

Here's how it's done. The highly stable, solid state servo requires less adjustment. Captain rollers are quickly changed. Settings are quickly made. The head assembly is isolated. (This makes the tape path highly stable. In fact, dynamic skew at start time is less than dynamic skew continuous.) And precision guides reduce static skew. There's no tape flap; an estate head isn't needed. Positive safety interlocks eliminate tape damage. Instantaneous speed



variation has been reduced. Plus, up to 350 ips tape speeds; 2 ms maximum start time; 1.5 ms maximum stop time; 800 bpi capability with or without clock track; available as a complete tape memory system with transfer rates up to 240 kc. And above all, there's AmpeX reliability and ruggedness throughout. The TM-5 is made by the AmpeX Computer Products Co., Culver City, Calif. For information write AmpeX Corp., Redwood City, Calif. Worldwide sales, service,



Cubic offers first solid-state, 10-watt and 2-watt telemetry transmitters to meet full IRIG standards

Cubic's new Type IV Telemetry Transmitter is the first all solid-state, 2-watt airborne unit to meet all the standards established by the Inter-RANGE Instrumentation Group. Rugged construction is employed throughout, including use of a casting for the chassis and internal EMI shielding. The Type IV measures 5" x 3½" x 2½", weighs only 28 oz., and is suitable for all missile environments. It has been selected for use on a major satellite series.

Cubic Type IV is a crystal-controlled, frequency-modulated transmitter for the 225-500 mc range. It exhibits the low power drain and long life required for space vehicle applications. A Type V Transmitter, measuring 5" x 3½" x 4½" and weighing only 56 oz., is also available. It provides 10-watt output by means of additional stages of amplification.

These new telemetry transmitters are available for fast delivery. For more information, write to Dept. B-111, Cubic Corporation, San Diego 25, California.

LEADER IN INDUSTRIAL, SEDIMENTIC AND AEROSPACE ELECTRONICS

SPECIFICATIONS TYPE IV TELEMETRY TRANSMITTER

Size: 5" x 3½" x 2½"
Weight: 28 oz.
Power output: 2-watt minimum
Power input: 6.5 amps max. 22 to 25 VDC
Detector sensitivity: for 5V peak-to-peak input signal -13000C
(Detector -1000A, 1500L)
Temperature: -30°F to +150°F
Mod. Freq. Range: 100KC
Shake: 100G
Vibration: up to 15G at 3000 cps
Altitude: up to 8 x 10¹⁰/in. Hg



*If you need reliable, no-leakage seals
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get the facts about Gask-O-Seals.
A FREE engineering consultation
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**Could you help give
our military commanders
one more second for
decision and action?**

MITRE's principal mission is to help make war impractical. Example — the design and development of systems that enable military commanders to detect attack and retaliate instantly and conclusively. Or the creation of systems that can survive nuclear confrontation. Systems for secure communications

systems for nuclear detection; systems for localized military operations; systems to help end nuclear conflicts.... these are some of the other assignments you may undergo at MITRE.

This work is important to our country. It also presents one of the greatest challenges in the systems sciences. MITRE is located just 20 minutes from Boston in the middle of a fast growing academic community, near mountains and seashore.

MITRE needs oriented engineers and scientists. If you are interested, write

Vice President — Technical Operations, The MITRE Corporation, Box 800, Bedford, Mass. Operations are also conducted in Washington, D.C., and Colorado Springs, Colorado.
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Reader in the design and development of communications systems, optical, ultralow, digital voice, and microwave systems for the transmission of radar information, voice, ultralow, digital voice, and all types of high speed data via microwave and troposcatter. It is involved in tactical missile control, fire control, and air-to-ground communications.

When the enemy strikes, nothing is as important as fast and reliable communications. That's where the AN/FDC-17 multiplexer plays a vital role.

The AN/FDC-17 is used for the transmission of radar information, voice, ultralow, digital voice, and all types of high speed data via microwave and troposcatter. It is involved in tactical missile control, fire control, and air-to-ground communications.

Lenkurt Electric was chosen to design this system to specifically meet the stringent requirements of several military applications. The resulting system is a proprietary item of the U.S. Government—the only multiplexer of this type so designed. Capable of 100% data loading, and switchable in configurations up to 660 channels, the ultra-reliable, solid-state AN/FDC-17 can withstand the high shock levels of

Listen!



hardened missile bases or transportation over unprepared terrain.

Although the system was designed to give superior performance over 600-mile circuits, it has been proven over circuits of 15,000 miles. Already, there are more than 150 fixed office, shipborne, airborne and mobile installations throughout the world.

Lenkurt Electric Co., Inc., San Carlos, California. Other offices: Washington, D.C.; Rome, New York; Santa Monica, California; Cocoa Beach, Florida.

LENKURT ELECTRIC
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EDITORIAL

Survival in the Space Age

(National Aeronautics and Space Administration) Feeling that public interest and congressional support for its programs are waning, has begun to emphasize the contributions it is making to the national defense (see p. 32). Dr. Hunter E. Nunnally, director of NASA's Office of Space Sciences, explained the importance of the groundwork in the introductory lecture at an artificial satellite conference in Blacksburg, Va., last week. Because of the growing interest and concern over the military aspects of space, AVIATION WEEK & SPACE TECHNOLOGY is presenting significant excerpts from Dr. Nunnally's talk.)

The entire world's creation of the man-in-space program—the primary objective of such a program is to develop the capabilities of man to operate and do things in space, and—*the nation by which this is to be accomplished is to send men to the moon.*

The Defense Dept. working on applications of space to develop and maintain our military strength that we can never be found wanting in any capability required to maintain our freedom and our safety. Also,

... this broad activity in space is underpinned by a program of advanced research in fundamental science and technology, carried out both in NASA and in the Defense Dept., to ensure our continuing capability to move forward along the most promising avenues of exploration, science, and application.

The outcome of this broad program which occupies the early years of the space age will be of far-reaching consequences for our country and for the world. From the scientific and technological research will come precious additions to our stockpile of knowledge. As the frontiershand of these technical and engineering march that all the areas today, much knowledge is right there in the world. Among these technical and engineering march are space applications, both civilian and military, the significance of which can be immediately apparent.

All of these are very important and valuable outcomes of our investment in space. But more important, far more important, is another outcome.

And, if necessary, we can thwart the attempts of any enemy to tax space against us.

As that day and age we cannot afford to ignore this first point. In our own self-interest, and for the safety of our country, we cannot permit others to develop space capabilities that we cannot match, and that must, therefore, be used dominantly against us.

This is a capability we must have to ensure our survival in the space age as independent, self-determining entities that our freedoms set up to be and that we have always insisted on being.

This is the capability that we shall have from the development of the ability to investigate scientifically with satellites and space probes, from space applications, from the ability to perform manned space flight and uncrewed space operations, from the vast complex of manufacturing and assembly plants, launching complexes, tracking and telecommuting facilities, and from the invaluable experience that that initial stage in the space program will give us.

This is the most significant point about the present era in space. This is the most important aspect of the present activity in space.

The Necessary Capability

We are now laying the groundwork for whatever role we must have to play in space in the future. We are ensuring that no one will ever be in a position to use space against us while we, helpless and frustrated through lack of the necessary space capability, have to take what comes.

In evaluating the space program, we must never lose sight of this broad aspect. It is this that gives the effort its urgency, and its compelling nature. The vast total of scientific, application, technology, manned flight through space, training of manpower, development, construction and operation of facilities, the strengthening of our military position in the world—which add up to our ability to choose our own destiny in space as we have done on earth—that gives to the space program its great value and importance to our total well-being.

Those who argue that we should dispense with the bulk of scientific and space exploration and concentrate on the necessities of military development forget that we can't really say what the military necessities in space will be. Our crystal ball is not that good, and it would be foolhardy to pretend that it is. We do not wish to develop a Maginot line in space, only to have it broken by forces of greater flexibility. We need to develop in a broad way our space capability so that we shall have the ability to move in any direction required by future events to meet any threats along whatever lines they may develop. . .

NEW!



Insulated wire undertread reduces cutting on BFG tires

This is the new B.F. Goodrich "Cut-Protected" commercial aircraft tire for main wheel use. As the name implies, tests have proved, the tire reduces over-cuts cutting and damage, and increases the number of times the tire can be re-treaded. This significantly reduces tire cost per landing.

The "Cut-Protected" tire is built with shielded wires distributed through the undertread. These shied wires cut that do occur from growing, and damaging undertread and ply area. The shielded wire banner is insulated from the tread by a double nylon shield. This stabilizes the tread rubber when

the tire under load and eliminates groove cracking.

The latter should also give the re-treader a simple visual reference when buffing. The re-treading operation is made more accurate and economical—and mistakes due to buffing too deep are eliminated.

This new tire incorporates the advanced design and compounded tire that goes into other B.F. Goodrich aircraft tires—selected tire after tire for the toughest jobs. For tires you can depend upon, specify BFG. Contact B.F. Goodrich Aerospace and Defense Products, a division of The B.F. Goodrich Company, Department J.W. 4, Akron 16, Ohio.

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Exhibits "A"



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WHO'S WHERE

In the Front Office

De Clark Miller, Director of the Goddard Astronomical Laboratory at the Goddard Space Flight Center, has been appointed director of the Advanced Concepts Center, Ames.

Edward F. Denehy, appointed executive director of the Goddard Aerospace Board, Washington, D.C.

Mervin P. Reid, president of Martin Marietta and Specialty Inc., Los Angeles, Calif., succeeded Robert Novakaitis, now board chairman.

Howard J. Sussman, president, Werner Corp., Louisville, Colo., succeeded Thomas J. Sussman, who continues as chair man.

De Ward M. DeGraff, president, West Coast Applied Science Corp., West La Jolla, Calif. De Graff has been promoted two years later of service as head of the school's School of Aerodynamics and Engineering Sciences.

Thomas J. Schenck, president and lead designer, Systems Engineering Laboratories Inc., Fort Lauderdale, Fla., succeeded William W. Bullock, Jr., who has joined Thermo Chemex Corp.

J. Frank Frazee, president, Frazee-McCormick Industries, White Plains, N.Y., a subsidiary of GTE, Div. General Precision Antenna Group.

M. E. Koenig, vice president licensing, Radio Corporation of America, New York City, and Stephen S. Bauman, division vice president, television operations, RCA, joined the board.

Stephen Van Pelt, president, Removal Design, program director, Convair/Ft. Dix, Air Force, James Scherzer, manager, Milt Davis, an executive vice president, Technical.

Fred D. Langford, a vice president, Holmes Electronics Corp., Los Angeles, Calif., responsible for marketing.

Ramone de Mimoso and Eugen V. Koenig, vice presidents, Pan AmericanGrace Airway Lines, Inc., Koenig continues as assistant to the president.

De Winton Glasson, vice president, Space Research and Systems Div., American Science and Engineering Inc., Cambridge, Mass.

Mark Rose, executive vice president, General Antennas, Inc., and Ben Peoples, vice president, operations.

Kenneth M. Coopersmith, corporate controller, Wyle Laboratories, Inc., Seal Beach, Calif.

Capt. Donald C. Campbell, USAF, USAF, the Commanding Officer and Director of the U.S. Naval Radiological Defense Lab center, San Francisco, Calif., commanding Capt. E. B. Roth, retired.

Honors and Elections

Walter Kohl & Company, Inc. has been granted the 1967 Award of Achievement from the Society of Manufacturing Engineers.

The Military Air Transport Service (MATS) has been awarded the Telfer Trophy for excellence in procurement management efficiency in 1967, the AFAC.

(Continued on page 118)

INDUSTRY OBSERVER

►First night flight deckhand of the Pratt & Whitney liquid hydrogen fueled engine at the National Aeronautics and Space Administration's General Environmental Testbed upper stage will be attempted on the fourth Altair Centaur version. Second Centaur vehicle, now scheduled to fly late in September or early in October, will earn about 550 environmental tests, chiefly for monitoring acceleration forces and the guidance and control system. Second Centaur is being programmed to burn for about 380 sec.

►Program to investigate techniques for detressing the attitude of a passive satellite by means of liquids contained on the satellite from a ground station is planned by Rome Air Development Center, RADC, in seeking qualified sources for the program, which is identified as U-436.

►Air Force's Reliant Systems Div. is considering plans for a two-stage, solid-propellant rocket apparatus with 125 lb. in diameter and capable of being deployed in existing Minuteman sites. Payload anticipated for the lower stage is high as nine tons.

►An unusually sensitive piezoelectric transducer, originally designed as a seismic seismic detector, has successfully detected the death heartbeat of a chicken on bypass—the first time this has been done without inserting probes into the egg. The device is expected to have widespread application in the space sciences, where a rugged, highly sensitive and extremely accurate sensor is required. The transducer was developed by Vernon Siegel, founder of Fuzor Bagels who invented the Bagelite song.

►First flight of the Long-Termin-Vought XG-142A aerospace VTOL transport prototype had delayed twice since March 16, before contract engineer kept reported overtime to be held to a minimum in order to use while the funding available. LTV has completed and released all engineering drawings in the shape; 80% of the tooling has been completed and about 40% of the detail parts have been fabricated. Since, a team number with 100s on the XC-142A, has completed the fast wing, end fair and fairing are taking shape as assembly goes on LTV. Hamilton Standard completed a 10 hr. test on the tail rotor gear box in a few days.

►Program definition phase reports on a military communications satellite system submitted last week in USAF's Space Systems Div. to General Electric and the team of Flikko and Space Technology Laboratories, both estimate weight of a second-stage Lockheed Agree plus six satellites at about 1,600 lb. Satellites themselves will not carry dual equipment for standard service, although Flikko has proposed use of two tracking wave output ports because it is the least expensive element (AW Job No. 29, p. 13).

►High-performance Bell UH-1B testbed (AW Job 16, p. 51), which new less powerful Continental 1000-hp engine mounted externally on either side of the cabin to boost performance into the 300-kts. range, is expected to begin this month its evaluation program for the Army's late next month. Modification is being performed by the Swastek Corp., San Antonio, Tex.

►USAir/Martin Titan 2 scheduled to fly from Cape Canaveral late next week, now to carry the subsatellite detection system intended for the Titan 2 that will launch the two-satellite NASA Gemini capsule. Titan 2 has been off the Atlantic Missile Range for some time now, so both USAir and NASA attempted to work out an integrated plan for testing various Gemini launch vehicle components on the seven minutes remaining in USAir's flight test series.

►McDonnell expects to demonstrate next year a chemically powered, open-cycle 20-wattatt compact diodelectric power source that will produce extremely high power for short periods of time from a low-cost compact package. Advanced Research Projects Agency is supporting the project with space and other military applications in mind.

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Washington Roundup

Research Dilemma

Congress is groping for a way to control the billions of tax dollars being spent on modern science but the old traditions of seniority and committee prerogatives keep getting in the way.

Senators and representatives, especially the younger ones, are admitting to guilty consciences about the haphazard way Congress approves research funds and are demanding more legislative machinery.

One group of representatives is pushing for a special *science committee*, to be appointed by the House speaker, which would take a broad look at federal research and try to coordinate it and find soft spots. Rep. Carl Elliott, sponsor of the motion to establish the special committee, contends the \$149 billion the government plans to spend on research this fiscal year "is not necessarily alarming" but "we must make certain that funds are spent wisely."

Chairmen Carl Vinson of the House Armed Services Committee and George P. Miller of the House space committee claim they already have this job and are taking it seriously. Rep. Vinson last week claimed the special committee would lead to the kind of duplication Congress loathes telling the executive branch to eliminate. Chairman Charles Hinckley of the House Military Operations Subcommittee and daily that no five representatives, regardless of the size of their staff, could even begin to understand, let alone evaluate, the full federal research effort. But leaders of the machine want Congress never make a try.

Senate Proposal

Sen. E. L. Bartlett last week introduced a bill to create a Congressional Office of Science and Technology (COST) composed of what he called "scientific generalists" to advise congressional committees. He sees COST as a clearing house where committees could obtain expert guidance. Now, he said, "Congress has no source of independent scientific wisdom and advice. Far too often congressional committees get expert advice only upon the testimony of the very scientists who have conceived the program, and that is not enough."

The grandfather of course will be the least far-seeing congressional committee to protect their interests by taking a closer look at research money requests and may well lead to more new legislative machinery. In short, research money is going to be harder to get from Congress from now on.

Chairman Richard B. Russell of the Senate Defense Appropriations Subcommittee made to go the Fiscal 1964 military budget bill moving this week by holding hard review hearings—no more than two days—in the last step before sending the measure to the floor.

Solids? Future Gloomy

Authorization has not decided to cancel or stretch out development of 156-ton and 260-ton solid rockets and only intends any liquids, at least through Fiscal 1964 and 1965. This decision, moreover, will not affect development of the 12-ton solid strap-on booster for Titan 3. Chairman George P. Miller of California, where three of the four liquid rocket plants are concentrated, will press the NASA to take over the initial programs if DOD cancels it (AW Aug. 5, p. 25).

SSD Dyno-Soar Role

Responsibility for flight testing the X-20 (Dyno-Soar) will be transferred next month from the Astronautical Systems Div. project office at Wright-Patterson AFB to the Space Systems Div. at highwood, Calif. ASD still will direct flight objectives.

Since SSD had performed the Gemini in a winged vehicle, the transfer is seen as an attempt to unify USAF space enthusiasts behind the Dyno-Soar program and perhaps lessen elements of its cancellation. Systems Command has broadened the X-20 base by directing Electronics Systems Div. to investigate communications and tracking problems. Plan call for SSD to conduct both air-drop and booster launch tests of the X-20, taking over the pilot training job from Edwards AFB.

J. Kenneth Colwell, former administrator to India, will go to Ottawa this week to represent President Kennedy in the effort to resolve U.S.-Canadian missile rights problems (AW June 1, p. 34), principally Canada's demand for more U.S. traffic rights for Trans-Canada Airlines.

Management of NASA's Marshall Space Flight Center is being strengthened through the appointment of Robert W. Young, vice president and general manager of Avco-Cessna's Sacramento plant, as director of projects and military operations. Starting Nov. 1, Young will supervise contractors working on the Saturn I, IB and vehicles. His job will consist work at NASA's Michoud plant and Mississippi Test Facility.

Washington Staff

Test Ban Would Not Cut Defense Budget

McNamara sees no reduction in 'foreseeable future,' no decrease in U.S. nuclear superiority over USSR.

By George C. Wilkins

Washington—U.S.-Russia agreement on a nuclear test ban treaty does not put any reduction in military spending for the foreseeable future, Defense Secretary Robert S. McNamara told the Senate last week.

"Perhaps the most serious risk of this treaty is the risk of euphoria," McNamara told the Senate Foreign Relations Committee. "We must guard against a condition of mind which allows us to become lax in our defenses. This agreement is a product of Western strength. Further progress in arms control arrangements with the Soviet Union—perhaps which we all want to make—depends critically on the maintenance of that strength."

Using metaphor of a man, McNamara elaborated on this theme in response to Senator who asked whether this apparent first step toward cutting Cold War arsenals could be compared to a reduction in the Defense Dept. budget. "A man who gives up the treaty is as well prepared for the battle as...an important offensive in the budget," McNamara said.

From a steady military viewpoint, the U.S. has more to gain than to lose by approving the nuclear test ban treaty, he said. This view was questioned by Dr. Edward Teller, nuclear physicist, who discussed the treaty dur-

ing a closed session of the Senate Foreign Relations Committee yesterday. In emerging Subcommittee findings, Dr. Teller said, "I do not believe there are significant advantages or disadvantages to operational nuclear weapons systems.... I do not believe they are any more than we have developed effective systems for defense against missiles."

Soviet and U.S. expenses with blockade of communications and ABM today by nuclear explosive "appear to be comparable," McNamara said. Both sides have concluded about the same number of high-yield tests at comparable yields and altitudes, he said, adding that the Soviets have had the U.S. experience of perfect effects of the types of yields and altitudes in which we are most interested. A better understanding of the blockade phenomenon—which would result from tests prohibited by the test-ban treaty at test permit some reduction in the number of ABM sites required per ABM system," McNamara said.

ABM Development

In sum, McNamara contended that while within a year, we could prevent the Soviets from launching an ABM system, "We still...are deployed systems which the Soviets will have to base in the next few years will probably not be as effective, slower initially, yet more effective, than the Nato-Zero."

Gen. Maxwell D. Taylor, chairman of the Joint Chiefs of Staff, told the Senate Preparedness investigating Subcommittee that the joint chiefs felt "development of the U.S. system does not depend on atmospheric testing and hence this treaty will not significantly interfere with readiness that we need."

Teller countered Russia was ahead of the U.S. in developing a missile defense. He said existing atmospheric tests required in the U.S. ABM being planned "in a hurried manner." We can have no confidence in missile defense unless complete operational tests are taken out."

• Big Blockade development, McNamara and Teller had tested bombs of 60 kiloton yield, which had been successfully implemented at about 100 megaton. "The 10 megaton Russian bomb is used in a lead pellet to penetrate fallout—a positive which reduced the yield but one which would not be taken in warheads," he conceded that in the

U.S. to Keep Nuclear Test Readiness

Washington—U.S. will maintain a constant state of readiness so that nuclear tests can be conducted without notice if Russia breaks the treaty limiting tests in the atmosphere, space and underwater. (See page 28, p. 150.)

Chairman George T. Seelig of the Senate Foreign Relations Committee has urged that the U.S. would be able to begin testing in six months to one month and no more than six months after the treaty was ratified. He recommended ratification of the treaty.

Faced tests to determine precisely the yields of a weapon short to enter the stockpile could be conducted within a month, he said. Development tests of designs, not final weapons, could be conducted within three months and tests of the effects of nuclear explosions could be conducted within three to six months.

Development of nuclear weapons will continue unhampered by this treaty, he said, adding that it is unlikely to affect current plans to develop a limited strategic nuclear warhead. Unprepared to produce warheads for battlefield, an defense, anti-satellite and anti-submarine role. He said a program to develop defense devices could be pursued without reducing the treaty. Defense Secretary Robert S. McNamara said that eventually tests of up to one megaton weapons might be made underground.

"Complete shadow resulting blast and fallout as well as radiation effects derived at strategic weapons delivery ranges would be responsible to 'say' out," Seeling said, as well as studies of the effect of nuclear weapons exploded at operational altitudes. However he said, Russia would have to make the same assumption.

He agreed with McNamara that atmospheric testing was not essential to develop new nuclear weapons. "We already have a number of warheads eligible for this purpose," Seeling said. "It is just a matter of the posture spending the type it wants."

Seeling said the U.S. instead of Russia "in the overall view is the nuclear weapons side. He will test weapons" to "to the degree that results missile-free negative and fractional megaton" weapons. He said the treaty gives the U.S. warheads of maintaining its nuclear superiority.

and can be avoided through nuclear ground testing, which is not required by the treaty. "We have tested the warhead (for the ABM) to the extent where we are certain it will work," he said.

As for the competitive U.S. and Russia programs in developing an ABM, McNamara said, "I do not believe these metropolitan centers are in position to implement such defense systems. We are working on a system which is far more than we have developed effective systems for defense against missiles."

Soviet and U.S. expenses with blockade of communications and ABM today by nuclear explosive "appear to be comparable," McNamara said. Both sides have concluded about the same number of high-yield tests at comparable yields and altitudes, he said, adding that the Soviets have had the U.S. experience of perfect effects of the types of yields and altitudes in which we are most interested. A better understanding of the blockade phenomenon—which would result from tests prohibited by the test-ban treaty at test permit some reduction in the number of ABM sites required per ABM system," McNamara said.

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Teller Says Treaty Has 'Grave Consequences'

Washington—Dr. Edward Teller, nuclear physicist who serves as a consultant to Air Force's Strategic Systems Dept., has championed development of the hydrogen bomb, claimed another less testy body, has "given greater priority for the security of the United States for the first time."

He told the Senate Preparedness investigating Subcommittee that the most significant advantage was claimed for the treaty but he himself has "some reservations" in referring atomic tests in the stratosphere, space and underwater.

There are difficulties, Dr. Teller said, because the treaty: "Cannot be completely policed"; "Will permit the Russians to attain their objectives in spite of negative embargoes. With the help of space testing the Russians can even surpass the advantages"; "Will permit the U.S. tests, although to verify the existence of one missile site. The USSR on the other hand can proceed with such experiments"; "Will impede the development of missile defense.... Your competing institutions in Russia will be very much less efficient."

use of "very large yield weapons" the Soviets have "advantage" which the high altitude atmospheric testing might make difficult to overcome.

But McNamara and the U.S. decided to go into a missile test zone to develop smaller nuclear weapons rather than the atmospheric weapons used in this test—would develop a 50- to 60-megaton bomb which could be delivered in a B-52 bomber. He said hydrogen weapons had many more bombs (11) two or three smaller ones "achieve a higher avoidance of ABM"; big warheads are inferior in second strike weapons because they are more difficult and expensive to hide, hide and deliver. "One may stay with full confidence that the shield from an assault of a bomb greater than the one we can handle, the treaty will not cut just the effectiveness of our strategic forces," McNamara said.

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Teller View

Teller said it is "entirely possible that we have neglected to consider in properly to evaluate target effects of high yield explosives which may render them potentially dangerous." But said he did not place "very great importance on the fact that the Russians can do the same thing."

• Hydrogen experiments, McNamara and Teller had tested bombs of 60 kiloton yield, which had been successfully implemented at about 100 megaton. "The 10 megaton Russian bomb is used in a lead pellet to penetrate fallout—a positive which reduced the yield but one which would not be taken in warheads," he conceded that in the

case of a nuclear warhead for the hydrogen bomb, "we have the Soviets have conducted no such tests." Unprepared to verify the U.S. knowledge in this area, Soviet scientists in this field, he said, "are not great in our."

• In addition with respect to the use of [Project] Echelon outside the territories of the U.S. this can give the Russians' possibility to interfere in our dealings with friendly or neutral nations."

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McNamara said "the most positive view of these uncertainties" suggests that a large Soviet nuclear bomb could knock out the missile test range less than two of my three deepest Minuteman silos." It is clear that the Soviets do not have the ability to knock out the American range to knock out our Minuteman force. Even so, do they appear to have increased ability to knock out our missile defense?" McNamara said. If Soviet strategic change he predicted the U.S. would learn of it in time to expand and further defend the Minuteman force.

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Under the terms the U.S. will live in relative peace, "an extensive, extrapolation, to predict the effect of war on our morale methods. Regardless of the design of an Soviet ABM system, in view of the nuclear importance of the U.S. and the potentialities of the U.S. ABM system, to inflict losses on us, the Soviet Union, in the course of this war, will not be able to knock out our ABM system. Even so, do they appear to have increased ability to knock out our missile defense?" McNamara said. If Soviet strategic change he predicted the U.S. would learn of it in time to expand and further defend the Minuteman force.

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Senate Restores Part of NASA Fund Cuts

By Donald E. Fink

Washington—National Aeronautics and Space Administration's fiscal 1981 authorization bill goes to a Senate-House conference committee that would indefinitely postpone House members' bill to keep the final authorization close to the lower House dollar figure.

The Senate approved a \$5.5 billion figure for the space agency, as opposed to \$5.2 billion proposed by the House (AVW, Aug. 12), plus \$100 million originally requested by NASA's original request for \$5.7 billion.

Senate conferees have been causal to the committee, which will resolve the difference between the two bills and then refer the final bill back to both chambers for approval. A fight is expected, however, in the naming of House conferees.

Rep. George P. Miller (D-Calif.), chairman of the House space committee, and his experts believe that House conferees will be compelled to accept the Senate's figure, since "we must be leaving the NASA budget at least as low as possible."

In the next legislative move, the independent Office of Technology will conduct hearings this week on the

NASA appropriations bill. Agency officials will be called in to testify in what amounts to a reorganization of the NASA budget. The appropriations hearings usually involve a routine reorganization of funding requests, but opponents of the cuts of NASA's budget may use them as a means of attempting further cuts.

Following the hearings, legislation will be introduced by the House to appropriate funds which cannot exceed the amount of the final congressional authorization bill.

The Senate version of the authorization bill was passed by voice vote after limited debate over an amendment that would have required the Communications Satellite Corp. to subordinate NASA for research and development costs.

An amendment finally adopted was proposed by Sen. Clinton P. Anderson (D-N.M.) as a substitute for one proposed by the Rep. Bill Stiles (R-Tenn.). The Anderson amendment would have required the independent government funding of research and development for the exclusive use of one organization other than a government agency, providing communications service (see box, below).

NASA Counsel Research Stirs Debate

Washington—Demands that the Communications Satellite Corp. reimburse the National Aeronautics and Space Administration for research and development costs highlighted Senate debate on the NASA fiscal 1981 authorization bill.

The debate resolved itself in a measure proposed by Sen. Alan S. Krasner (D-N.J.) that would have required the corporation to contribute the proceeds from a corporate share of its satellite research equipment.

Sen. John D. Edwards (D-N.C.) who led the filibuster fight against creation of the corporation last year, did lead a brief attack Aug. 14, but apparently suffered a cold attack during the Senate debate two days earlier.

Sen. Ted Kennedy (D-Mass.) charged that the Senate proposal was to force that "very private company that receives the benefit of taxpayer research and development" to contribute part of all costs.

The Senate and NASA's proposed expenditures of \$81.1 million for research and development of advanced communications satellites represented a great move to the satellite corporation. His views were echoed by Sen. Wayne Morse (D-Ore.).

Sen. Clinton P. Anderson (D-N.M.), chairman of the Senate space committee, argued with the senator that "any portion of the authorization bill less than \$81.1 million on behalf of the Communications Satellite Corp."

He said that information released publicly on the communications satellite awards would be available to the corporation but to "any other interested party in government and industry" as well.

Thus supporting the Krasner amendment controlled the satellite corporation has a monopoly on the operation of a communications satellite network and therefore would be the sole beneficiary of any government sponsored research and development.

Sen. Anderson agreed that the telecommunications industry also could be used for ship and aircraft navigation, activities in which the satellite corporation is not involved.

Sen. Anderson then proposed a substitute amendment which stated that some of NASA's funds could be used to fund technical services "for the exclusive benefit of any private enterprise, such as the corporation, except on a reimbursable basis." The amendment was approved by a 66 to 12 vote.

The Senate bill also included an amendment by Sen. Jack Nifele (R-Kan.) requiring that committees set up to study the proposed Boston Electronics Research Center give the Kennedy Administration written notice that they have no objection to such a center or to the location of it.

The Senate proposed authorization of the full \$5 billion requested by NASA for first year funding of the \$50 billion center. Sen. Nifele had the amendment to cut \$3 billion after agreeing an amendment that would have eliminated authorization of any funds until NASA presented further justification for the center to Congress next year.

A similar amendment proposed by Sen. Carl T. Corzine (IL-D) also was rejected by the Senate, in spite of an amendment proposed by Sen. Frank J. Lautenberg (D-N.J.) to restore the Senate authorization to \$167,931,000—so the House approved figure.

NASA pursued the House cuts on the assumption that it would either face a shutdown in Project Apollo or negotiate cuts in all of its NASA programs in order to channel sufficient funds to the human space flight (AVW, July 25, p. 32). Reductions of \$120 million in Apollo spacecraft funding was listed as being of primary concern, since it would result in a 4 to 6 month delay in the availability of command and service modules for initial lunar flights. Concern was also raised over increased mission risk due to lack of redundancy.

During the final portion of the Senate debate on the authorization bill, NASA was criticized by Sen. Mike Mansfield (D-Md.) for not placing more emphasis on making advances in automated design.

"It seems incredible to me that an agency which claims the title of National Aeronautics and Space Administration would propose an expenditure in the hundreds of less than 1%," Sen. Mansfield said.

He said the authorizations bill limited only \$16.2 million for aviation research and development and that aerospace and aircraft engine manufacturers were protesting the lack of emphasis on advancing theeronautical technology.

"Certainly this area should be considered in connection with the carrying by the President of a billion dollar effort to be felt in aerospace transport (BSP) aircraft," Sen. Mansfield and Corzine (p. 17).

To arrive at the \$5 billion figure, which NASA is in a position to spend in SST development, "one must include

a disproportionate amount of the personnel costs and the full amount for plant overhead," Sen. Mansfield said.

Sen. Mansfield cited recent announcements by US宇航 that they intend to buy the Anglo-French Concorde SST and a U.S. big in developing an intercontinental transport aircraft as examples of the need for space agencies in aeronomical research and development.

Sen. Anderson came to NASA's defense, saying the \$16 billion was only a partial figure covering research and development. To this should be added \$14 million in personnel costs and \$10 million for surveillance operations, for a total of \$81 billion, he said.

New Bids Requested For Air Force Tunnel

Second round of bids have been submitted in the Air Force's Avionics Systems Div. (Av Planc 2) of the construction of the new missile 30 H. transonic wind tunnel at Wright-Patterson AFB, Ohio, in a 50 segment facility to do dynamic testing facility, to do transonic and transonic ASD has ended in the middle of August.

Phase 2 includes the aerosol modification of the tunnel in power setting of new scale models of boost glide and aircraft vehicles under full, simulated stagnation conditions at hypersonic speeds. Phase 1 work included fabrication and installation of electrical equipment and a program being done by the General Electric Co.

Beech King Air

Beech aircraft demonstrators are taking final delivery for 1980, 2964, delivery of the Model 190 King Air, a 4.8 place pressurized executive transport powered by two PT6A-45 turboprops. Price is approximately \$1.2 million.

Construction of the first King Air 400 prototype is under way, with the new program separating both former Model 190 turboprop and Model 85, a pressurized jet-powered version of the Queen Air.

Beech specifications and performance data probably will be available at the company's distributor-dealer meeting in Wichita in mid-November.

Beech has accumulated since 1978, 18 or 19 test aircraft on a converted Queen Air powered by PT6A-45 turboprops built with an Avco design contract.

Beech apparently is dropping antisubstomp loading to a parametric subprogram level of the initial performance trend set in the PT6A-45 engines in the Avco testbed.

Space Suit Communications System

First of several operational prototypes space suit communications systems, developed by ITT Reliance Communications Systems Div. of International Telephone & Telegraph Corp. for use in the Apollo program, has been delivered to the space suit prime contractor, McDonnell Douglas Div. of United Aircraft.

Equipment will be forwarded soon to National Aeronautics and Space Administration's Lyndon B. Johnson Space Center, Houston, Tex. Two more prototypes are scheduled for the Aug. 29 and Sept. 10 dates.

EVSC (electro-mechanical communications system) was designed to accommodate results from NASA's evaluation of an advanced prototype developed by Spacelab Inc., Von Braun, Calif. (AVW, May 18, p. 48).

The EVSC prototype subsystem went to ITT as the basis of what was called "a better approach to the ITT portion" of the review. Spacelab will send an advanced development model of a new version, not part of any specific program to Houston to check those results for NASA evaluation. It provides greater physiological telemetry capability than the Apollo prototype, according to NASA.

Each Apollo equipped suit contains the best features of both systems.

Merritt Island Support Bids Due

Cape Canaveral-National Aeronautics and Space Administration's competition to award contracts for the three remaining packages of launching support for the agency's Merritt Island Launch Area (MILA) orbital 6.8 weeks.

The packages are bus services, administrative and management services, launch and support services. NASA's Launch Operations Center has plans to award about \$100 million to each of the first two enterprises and about \$10 million to the third launch support. Plans have not yet been made for the package.

A propositional bidder's conference possibly will be held about two weeks after the issuance of each work statement, and bids will be due roughly six to six weeks after each conference.

Completion of the packages will be staggered, with the day for the first assignment and the submission of bids, Launch Operations Center would like to have the contractors selected and on the job at MILA by the end of the year.

Earlier this year, when the center issued its 1980 support requirements in four areas (AVW, July 25, p. 33), it identified these tasks as representatives of each package:

- Bus services will include security, passenger and general transportation, medical, printing, research and engineering, and user port of supply.
- Administrative and management services will include space photographs up extraterrestrial field pointing plan, reduced telecommunication services and webmaster data processing.
- Launch support services will include complex component operations, payload services, payload integration, high pressure gas controller and compressor operations, energetic equipment cleaning and spacecraft servicing facilities support.

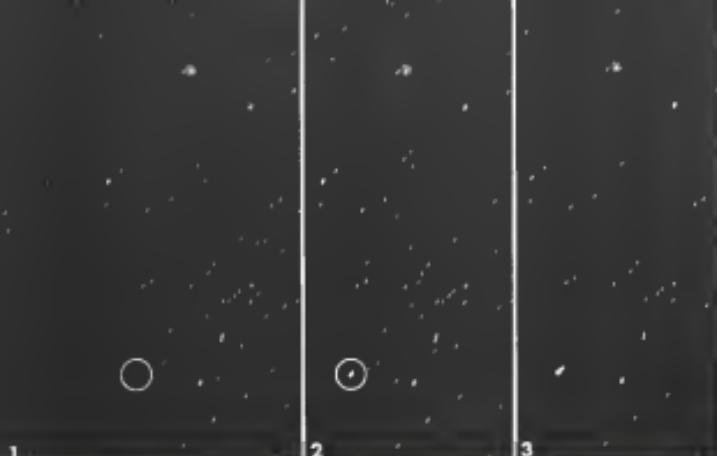
Boston Center Site

Cambridge, Mass.—Felt closed for a location for National Aeronautics and Space Administration's proposed Boston Electronics Center is a site near Brigham Circle, the site which would provide a portion of the new MILA orbital 6.8 weeks.

Site selection officials are currently discussing or seeking with the temple officials, Kelle, and how to work at the American Institute of Astronautics and Astronautical Guidance and Control Conference.

Kelle said that about 95% of the appropriated funds for the proposed \$300-million center would be spent "in-house." The initial \$7 million in appropriated funding would be spent to reduce 100 suggested locations for the center to five choices and then to just one land.

Kelle said a final congressional decision on the center's future would come within six weeks. The facility would include laboratory rates for space guidance and reference rates for ground guidance and reference rates and control systems. Alternative construction plans call for 12 buildings, an 1,000-acre site. Kelle added,



South African Station's Photo Sequence

Space Council to Check DOD Range Plans

Washington—Close examination of Defense Dept. plans for increasing the use of its global space communications and research networks to see if they duplicate civilian space agency plans will begin next month in the fiscal 1985 budget proposals such

highest Administration levels.

The first move under these plans would be to consolidate management of the three national missile ranges. A preliminary study of the consolidation is now being conducted here by USAF Maj. Gen. Leighton J. Davis, commanding officer of the Air Force-operated Al-

National Aerospace and Space Admin-
istration according to a high Adminis-
tration official, became of classified
projects whose secrets must be pro-
tected. But it is typical of military
planners to overstate their requirements,
he said.

Detection of these even requirements so that duplication can be held to a minimum will be the job of the controller.

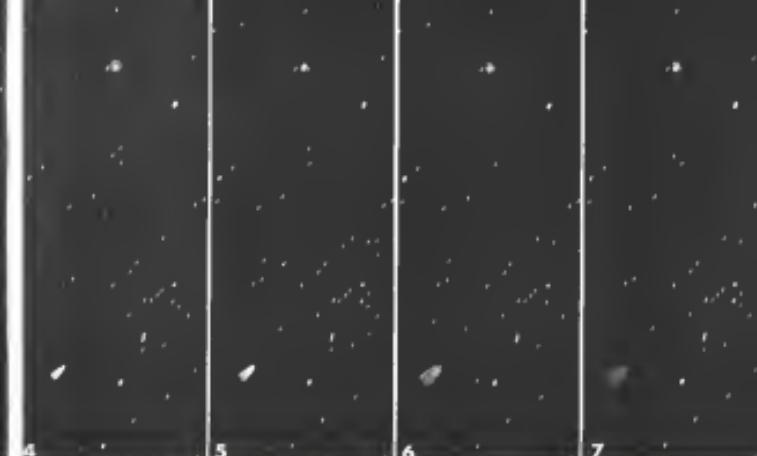
The Pacific range is now operated by the Navy and the White Sands range is Do Army. As of late last year

been officially asked for their reactions to the proposed consolidation. A Navy official said he would rather see the Pacific range management remain as disturbed but would not object to having it placed as a whole under a single manager. Army reaction was the same.

The Navy developed the Pacific stage, with bipropellants at Pt. Magu, Calif., to test submarine, ship and aircraft-launched missiles and to provide training for the crews.

To divorce these added facilities now from the Navy's basic usage would be

The McTigue was considered to



Shows Firing of Syncom's Apogee Motor

19 ms. The motor housed 19.9 cc., and at the time of burst (plots No. 8), the plane was 56 mil. long and 31 mil. wide. In the final photo (plot No. 7), the dimensions had reached 97 mil. in length and 66 mil. wide. The mettle is moving east northeast at the approximate flying of the solid-propelled engine motor, a jet Propulsion Laboratory development, took place 6 hr after launch at an altitude of 12,540 ft. (J.W.Ang. p. 57). Late last week NASA passed the switch's altitude mark 2,024 hours over a 13 mil. sec., 24 hr. speed record in altitude by just surpassing *Path* and reaching the altitude over 15.4 sec. West longitude. Initial data indicated the aircraft was recorded.

director of defense research and engineering. The single-manager proposal will have to be discussed with NASA officials, however, since NASA requires waivers for the Gemini-bound Apollo astronauts mission with an Apollo vehicle will require expanded control and communications facilities around the globe. The Apollo moon landing program will require further expansion and changes.

NASA has indicated that as long as the defense controlled networks are made adaptable to its needs, it will have no objection to consolidated messaging.

Entering into the cut-off space range picture is a basic difference between the Defense Dept. and NASA's, an advocacy side. The Air Force has proposed a triangle of lead monitors sites between Edwards AFB, Calif., Westinghouse, Md., and AFSC, M. S.

long with later German flights that would necessitate launching the capsules at low angles to the equator to take advantage of the earth's rotation for added velocity.

center. That boosts the lifetimes for missions and makes the area near Houston, Texas, more desirable.

CH-53A Aviations Winners
Washington Nationals Dan de Nagy, the Tokheim Sunoco Corp., and Textron Instruments have been selected by the Navy to conduct a Hemisearch program definitive phase aimed at de-

SAC is objecting, however, because it maintains that after space systems are developed by Systems Command and become operational, they will come under its control.

NASA Links Efforts to Defense To Broaden Appeal for Support

By Alfred P. Albrecht

Blacksburg, Va.—National Aeronautics and Space Administration has started to base much of its appeal for public and political support on the agency's contribution to the nation's military capability in space.

In a speech Aug. 12, opening the annual meeting of the Institute of Artificial Satellite Experts, Dr. Elwood E. Newell, director of the National Aeronautics and Space Administration's Office of Space Sciences, and the space program is issuing that "we will never be in a position to use space against us while our helplessness and vulnerability lack of necessary space capability may force us to take what comes."

NASA has been riding toward that position for some time. Two years ago the agency was able to emphasize the importance of its programs to the nation. Then, in large expenditures for peaceful purposes began to be questioned in Congress; the agency changed the focus of its justification to include the necessity for developing a space capability which could be applied to military requirements.

Newell said it is the development of a military capability that gives the space program "its wings and its compelling importance."

Referring to the broad nature of U.S. space efforts, he said that "those who argue that we should disengage with the fields of science and space exploration and concentration on the aerospace of military development, forget that we

Probing Physical Laws

Blacksburg, Va.—There are numerous indications that the Space Agency must begin some very fundamental re-examination that will challenge current accepted physical laws governing the universe.

"A number of researchers are already thinking seriously of the possibility of using gravitational clouds, in which the free-falling element is a dense orbiting satellite, to compare gravitational field forces and to search for long range changes in the value of the Newtonian gravitational constant," Dr. Elwood Newell, director of National Aeronautics and Space Administration's Office of Space Sciences, told the annual space conference here.

Dr. Hugh J. Dryden, NASA deputy administrator, had essentially the same strong if another recent conference (AW Aug. 12, p. 11).

one's rolls are what the military requires in space will be.

"We do not have to develop a Navy fleet in space only to have it flanked by forces of greater flexibility. We need to develop our space capability so that we shall have the ability to move in space as we see fit, as we judge events to meet our needs."

The Administration's and NASA's reasoning behind the switch in emphasis from peaceful pursuits to development of military space capabilities is that national defense is much easier to plan. Space spending was a noted drain between the years of 1967 and 1965, largely because of the natural increase over the Soviet Union's space capabilities.

The new space "spectacular" emphasizes more in its routine orbits, public relations work and congressional advocacy than development.

The House of Representatives cut about \$100 million from the NASA authorization for 1968, and although the Senate increased more than \$100 million at the cost, further optimism is expected from committee-estimated congressional figures (p. 78).

NASA and university researchers do visit considerable attention during the week-long conference to national defense issues, particularly the North and South American fronts.

While Dr. R. Hess of the Goddard Space Flight Center and Dr. R. J. Glass of NASA's Langley set the stage for the discussion of charged particles in the earth's magnetosphere by pointing out that the July 9, 1962, Stanford high-altitude nuclear test over Johnson Island and the subsequent study of particle fluxes in energetic particle spectra indicated that the earth's magnetic field lines connecting the ionized plasma belt had moved away from the equator concerning the effects.

This was first print in the Stanford explosion, he argued. And the theory that moving arcs striking the earth's atmosphere caused the areas of intense reionization electrons and protons, which were then captured by the magnetic field lines connecting the ionized earth's belt.

Consequently following the Stanford explosion designers for three, he said, had to re-examine that an injected belt of protons be excited by magnetic induction causes at the desired altitude. The protons, he said, would be relatively easy to identify and control and would therefore provide some means for understanding the mechanics which control the behavior of particles in the earth's magnetosphere.

Solar Protons

Blacksburg, Va.—Goddard Space Flight Center scientists will deduce soon that truly heliospheric protons from the sun "leak" or escape outward from near elliptical inclined axes, which trap or store them, in a 27-day period.

The Mariner 3 Venus probe found the plasma stream and it was confirmed by the Electron 14 satellite. Set influence of the Earth's particles on the solar wind is a product of that activity. But it cannot yet measure observable every 27 days the period required for a given point on the sun to return to the same position on the disk as when the next such periodic event occurs.

Others suggested that a proton belt also might clear up the mystery of electrons. He said it is not clear now whether particles come the interior or exterior of the inner zone a comet in just what comes the answer.

There had been agreement to detect and count protons in new being developed by Dr. Edward W. Hines, Jr., of the University of Michigan, Detroit, but that there is enough to oppose progress for being stored on a rocket or satellite.

General S. Haslett of the Smithsonian Astrophysical Observatory said that well-established statistical information on interplanetary velocities that in addition through analysis of ionospheric particles, the Apollo spacecraft will be hit at least once a month by a particle capsule. Apollo project officials indicated that the high-thrust body of the spacecraft will withstand the particles of the mass that the present stations indicate would shower the spacecraft.

Martian Atmosphere

Blacksburg, Va.—Recent spectroscopic studies of Mars indicate that the planet has a surface atmospheric pressure of 20 millibars, one-tenth the pressure of the most distant layer of 100 millibars. Dr. Thomas Svedberg of the Royal Institute of Technology, Stockholm, Sweden, told the meeting that the model particle nucleation law held true.

Fusion studies meant of confirming the 20-millibar figure are planned.

Tobet A. Clark, of the Naval Research Laboratory, reported that a soft X-ray detector in the 10-12 Angstrom region whose source of unknown was detected in an Apollo 11 sounding rocket flight from the White Sands Missile Range last spring. Clark said the source was determined and waited to only spring when NSSL has a more sensitive photometer.

Dr. Hugh J. Dryden, NASA deputy administrator, had essentially the same strong if another recent conference (AW Aug. 12, p. 11).

FCC Comsat Contract Role Questioned

By Philip J. Klass

Washington.—Industry is expected to protest strongly against a proposed regulation that would require the Communications Satellite Corp., its prime contractor and participating contractors to notify the Federal Communications Commission of their proposed choices of subcontractors for all awards over \$25,000.

But no FCC spokesman told *Aerospace Week & Space Technology* that the agency might be responsive to industry requests to waive the \$25,000 limit, which is far below the one used by the Defense Dept. Industry concerns are due by Sept. 10.

Defense Dept.'s Armed Services Procurement Regulation requires approval by a contracting officer on fixed price contracts only when they exceed \$25,000 or 5% of the total prime contract price. At the discretion of the contracting officer his figure can be set as high as \$250,000.

The proposed new procurement regulation are intended to change the FCC's responsibilities under the legislation which authorized the Communications Satellite Corp. FCC is charged with ensuring effective cooperation and appropriate procurement procedures in all elements of the space communications system.

Under the proposed regulations, Communications Satellite Corp., its prime contractor and various service corps would have to file certain information on each individual procurement over \$1,000, including names of all bidders, method of procurement used, copy of proposed contract and name of the managing bidders.

If the lowest bidder is not selected, reasons for the choice must be given. The purchasing company also must disclose any financial interest it has in the proposed recipient of the contract. Estimated from the proposed procedure would be procurement of solids or permanent services and contracts with an through government agencies.

Unless the FCC notifies the pending party to the contract within 30 days, the award can be made. An FCC official emphasized that the intent of the regulation is to enable the FCC to assess itself that the pending company has complied fully with the procedures other than those to place FCC in a position of appearing as disengaging a specific choice among contractors. But the industry spokesman called the procedure as "unprecedented extension by government into contractor procurement."

In addition to concern over the extremely low \$25,000 figure, industry spokesman are upset over the apparent intention of the proposed regulation to apply the procedure to awards made by subcontractors and joint-venture

*Two-step procurement, to be used only when available specifications or purchase descriptions do not permit benefit advertising without engineering evaluations and discussions with respect to the technical aspects thereof as to insure mutual understanding between contractors and party making procurements.

*Each party will call only for technical proposals. Preliminary evaluation of these proposals, notifications to bid and the award of contracts shall be established by those parties which technical evaluations have been eliminated as determinants to be acceptable.

*A lot of risk involved must be allocated to the FCC where contract exceeds contractor specified value and pricing practice is other than a subcontractor.

*Negotiated contract may be used when property or service to be procured does not permit procurement through either of the other two procedures, or if otherwise authorized by the FCC. Requests for proposals for such procurement must be published, and the proposed regulation provides under the "whichever is more economical and technically feasible." The procurement must be decided even before bids to permit bidding by small business concerns on quantities less than the total requirement.



First Major S-IC Assembly Completed

First major structural assembly for the Saturn V-IC booster, a fair tank upper dome, has been completed at Marshall Space Flight Center. Marshall will build four S-ICs at its Huntsville, Ala., facility (AW May 25, p. 16) plus one fair tank. Dome being lowered into a Y-wing part of the single fair tank to be built by Marshall. This unit will be tested to verify design loads, and results will be extrapolated to the ordnance tank. Beginning of construction of the four complete fair tanks is contingent upon verification of these loads. Dome shown here consists of eight two-piece gear segments and is 13 ft in diameter.

Unmanned X-20 Could Fly by July, 1965

By George Alexander

Cape Canaveral—Part of the maximum flights at the USAF/Bell Boeing Co. X-20 (Dyna-Soar) space vehicle could come as early as July or August, 1965, followed by the first six flights around October, six to eight months later, if the Titan 3 launch vehicle continues to be successful in meeting major program goals.

Gen. George S. Blume, program director of the Titan 3 (officially designated 6145), written at USAF's Space Systems Div., said that the first of these two numbers could be flown aboard the third Titan 3C research and development launch vehicle, if the last two "C" flights are successful.

Flight Test Program

Blume said that the 27-vehicle flight test program of five "A" and eight "C" versions of the Titan 3 (AW Feb. 23, p. 27) is planned to be completed within 45 months after the program's start at December, 1962, or about 36 months. Present plans call for the first Titan 3C to be launched in April, 1965. If this target date is met, it would leave 16-17 months in the program's B&D phase in which to fit the remaining 11 vehicles. If the program is lengthened, the last vehicle will place the launch date of the final Titan 3C, with its companion Dyna-Soar partied, around July or August, 1965.

A second unmanned X-20 mission also is planned the Titan 3 program duration and, confirming a prediction made by Aviation Week & Space Technology some time ago, the

(July 9, 1962, p. 15) it would be staged either with the fourth or fifth Titan 3C launch vehicles, depending on whether or not the first unmanned flight is conducted on the first "C" launch and whether or not it is successful.

Blumeen considers the fifth vehicle to be the most likely candidate for the first unmanned flight because it would allow USAF more time in which to evaluate the results of the first vehicle's flight test, if necessary, make modifications to the spacecraft.

Both uncrewed flights of the orbital gliders would be partially orbital, so effect the profile would be a high-lift trajectory carrying the spacecraft from low earth into three-quarters around the world to Edwards AFB, Calif. Because of an intact spacecraft there is no assurance it is considered doubtful.

Manned Flights

Manned operational flights of the Dyna-Soar are expected to begin before the first 17-vehicle flight test program is concluded. If USAF's present estimate of three-month intervals between X-20 flights, should prove valid, plus one or three additional months for detailed analysis of the two uncrewed missions, the first manned flight could demonstrate an orbital maneuver around the Earth.

The flight profile of the first manned mission is likely to be very similar to that of the two uncrewed flights. Second-manned flight might last for at least one complete orbit, plus a part of a second, with successive flights ev-

olving for longer and longer periods of time.

Blumeen said that USAF is confident that the Titan 3 will be exercised in the projected time frame (mid-July 1965). When the IC vehicles remaining in the flight test series after the start of operational flights, will be devoted to demonstrating of the vehicle's performance in different environments—temperature, ionosphere, equatorial upset, reentry or earth escape—the results of which might be redundant as far as man-rating is concerned.

For Titan 3A vehicles will be flown down here before the first IC flight, he said, with the first launch now scheduled for August, 1964. Fifth launch vehicle will be held until after the first IC flight, in that annotation noted in the Titan 3's own performance—possibly induced by the solid propellant motors—might be checked by this vehicle.

Circular Orbit

Although the first 3A vehicle, like the first 3C, will not carry men packed—these flights will be strictly performance tests of the launch vehicles themselves—Blumeen pointed out that one of the 3A vehicles will be programmed to demonstrate an orbital maneuver around the Earth through several reentries, orbital burns and the reentry profile of an Apollo Command Module.

On the other hand, the X-20's orbital radius will not change, so it is highly probable that this vehicle will have a period of extreme elevation occurring experimentally. Triangular reentry heat shield systems will be tested at this altitude.

Blumeen strongly emphasized that preliminary figures showed the 15 Titan 3 and 17 uncrewed vehicles (first "A" and "C") and their crews (one each) would be carried on a payload of space-available and non-recoverable hardware and that primary goals will be demonstrations of the launch vehicle's total performance.

Titan 3A configuration consists of a modified Martin Co. built Titan 2 ICBM, plus a third stage, called range stage also being built by Martin. Titan 3C version consists of the Titan 3A, called the core, plus two strap-on 7415-L long, solid rocket boosters, being developed under Defense Contractor of United Attack Engines Corp. (DUEC), which recently subcontracted its short-range missile success to AW (July 18, p. 37). The boosters will weigh 49,000 lbs, according to Blumeen.

Blumeen said that as of June 1, 1964, all hardware parts of the Titan 3, research had been released for production.

Martin Laser Yields Over 50 Watts

Orlando, Fla.—Peak power output of more than 50 w. from a pulsed gas laser has been demonstrated by the Martin-Mitsubishi Corp. team. The company, which started the series of experiments in late 1963, claims to measure the laser to more than 180 w. with only minor modifications to the present equipment.

At higher pulse repetition rates, Mitsubishi reported, the laser becomes an application of the copper-coated laser in optical fiber optics.

Precise advantage of the pulsed gas lasers over higher peak power solid lasers such as ruby rods, Mitsubishi says, is the higher pulse repetition rates available to the user. This capability would be important in the tracking of either airborne or orbital vehicles.

Mitsubishi said that it has operated its gas lasers at rates of 1,000 pulses per second (pps), with no drop in peak power. At 1,000 pps, however, peak power for this laser dropped about 30%.

Orlando said in the near future, the company will develop a solid-state laser with a peak power of 1,000 w. and a repetition rate of 1,000 pps.

The laser is a quartz tube, 150 mm long and 3 mm in diameter. It is a 400-tl.

second-pulse-rate pulsed laser with a timing signal of about one-half a microsecond.

Mitsubishi-Martin has built both the pulsed and the 1000-hr lasers at the cost of about one-half a million dollars.

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The company claims that the laser has good gas losses because shortening the spacing between electrodes has little effect on the laser output.

Blumeen said that as of June 1, 1964, all hardware parts of the Titan 3, research had been released for production.



First RF-4C Photos Show Reconnaissance Installation

First photos of the McDonnell RF-4C show major changes in the new configuration adopted for the reconnaissance version of the Air Force Phantom 2. Optics plates are provided for forward and side oblique cameras. Other detection devices are included in the reconnaissance package. Toward-looking radar is smaller and reduced to a 37% weight reduction in the new version. Studies made by Avionics Division Div. of Air Force Systems Command found that the radar specified in the System Operational Requirement exceeded actual aircraft requirements, and specification changes resulted in the smaller unit. The first flight (short) was made without the nose-camera system installed.



Navy Told to Cut Attack Carrier Force

By Lucy Boold

Washington—Navy last week was presented with the problem of reducing the size of its attack carrier force or losing Defense Dept. told the cut out. Although Navy was promised that it can acquire a slightly larger budget for fiscal 1965, it was told that the Navy must meet Defense Dept.'s demand to understand the implications and anti-submarine warfare surface forces are taking the carrier strike group.

The attack carrier fleet now numbers 15. Since each of them, there has been an reversal strongly for dollars between proposals of attack carrier forces, anti-submarine carrier forces other ASW forces—but neither and no—and the phosphate forces.

Only the nuclear-powered submarine and Polaris missile submarines have been entirely free of the budget squeeze.

A massive study of cost-based strike force was begun early this year (AW Feb. 21, p. 55; Mar. 4, p. 27). It was completed May 15 and forwarded to

Defense Secretary Robert S. McNamara in the Navy late in May. A parallel study on nuclear power for ships and the number of carriers needed was reported (AW May 6, p. 35).

What was supposed to have been a joint conference of Navy force and ship plan, between McNamara and Adm. David L. McDonald, Chief of Naval Operations, on Aug. 12, Adm. McDonald, who became CNO on Aug. 1, had prepared his own position paper, similar to one prepared by his staff.

The paper had little effect on McNamara and no formal presentation was made to the Navy force area present. But an exchange between McNamara and Adm. Donald McDonald resulted in a further delay of a decision.

That is when Fund 1965 budget report experiments will be made. McNamara was advised by a spokesman with Adm. McDonald's willingness to look at 45 sides of the question despite the fact that he is a naval aviator.

How is the Navy's force dimension in its new standards?

McNamara has ordered modernization of the amphibious fleet and its support ships as well with the overall increase in emphasis on fleet rather than aircraft. He also directed a number of aircraft to be converted into ships and has recommended Amphibious Fleet and ASW surface fleet are based on World War II design.

McNamara has also ordered increased emphasis on anti-submarine warfare capabilities, especially modernization of the surface fleet ASW forces and land-based ASW aircraft forces will remain about the same.

This leaves only the attack carrier force to provide to the services in the two categories above.

Defense officials believe that the number of attack carriers can be easily reduced without affecting the overall effectiveness of the force. They stress that the modern carrier of the Midway, Forrestal and Enterprise classes are operating more modern aircraft such as McDonnell F-4B multipurpose fighter,

resulting in an effectiveness increase as new aircraft have replaced old ones. The older Escort class aircraft operate much less effectively.

Defense Dept. delayed construction of heavy attack aircraft (HAW) until 1971 because they felt by the time of attacking forces that the political determination whether or not it should be nuclear or conventional-powered. Delays in budget reports from CIA and USAF Fund 1965 would result in further substantial savings. The entire package for a new aircraft, including personnel, training, ship cost and equipment amounts to more than \$100 million.

Further savings could be made by shifting one or more Escort plane classes to ASW ships and refitting an older ASW escort. However, only about 100 aircraft savings per year could be realized for each class because the number of ships have been written off for both the ship and aircraft.

Force Changes

Defense officials argue that force changes are bound to change with time. These changes now are causing stress in all three military services but the Navy gain, that is, stress driving down will become less distinct, so that the force changes will be accompanied with less concern.

These officials are in the reductions of the unarmed nuclear bomber fleet, the shift to missiles and the leveling off of the missile program as a correlate of changing character of forces. The Navy budget, which increased more in proportion than the other services in the last three years with the advent of inter-plateaued technology and morale launching advances, now faces a cut-off. The Navy itself is being given the choice of two ways of adjustment. If it fails, the changes will be made administratively by McNamara.

Here is the breakdown of the Navy's 15 attack aircraft:

- **Enterprise.** This is the largest combat ship in the world. It is 1,000 ft long and displaces 98,000 tons. It is planned to buy eight nuclear reactors. It cost close to \$500 million to build, even though inter-plateaued missile technologies were eliminated. Future nuclear power and conversion could be possible by reworking the design features and slightly slower. Never believe the reduced cost would grow exponentially.

- **Forrestal class.** These carriers, displacing over 30,000 tons each, are now finally powered and can operate the most advanced aircraft. The others of the class are the Independence, Ranger, Saratoga, Constellation and Kitty Hawk. They have joined the fleet in the last eight years.

- **Midway class.** These three 54,000-ton carriers were designed during World War II and completed just after the war. That was the first carrier to have armed decks. In addition to the Midway, the Franklin D. Roosevelt and the Coral Sea have had angled decks and improved stairs catapults and arrester gear installed. The three differ in landing gear configurations and can land either the most modern or the oldest carrier aircraft.

The original Essex is now an anti-submarine warfare carrier.

Another attack carrier, the America, is under construction. It is essentially similar to the Forrestal class. It will duplicate use of the Essex class attack carriers.

In the ASW carrier fleet there are other Essex class ships. Another six assigned to the Naval Air Training Command for pilot training.

Force changes are bound to change with time. These changes now are causing stress in all three military services but the Navy gain, that is, stress driving down will become less distinct, so that the force changes will be accompanied with less concern.

These ships will all have in World War II with straight decks. They have been converted in similar fashion to the Midway class but are considerably smaller and can only handle aircraft that are lighter and therefore have lower performance. These ships are rapidly approaching obsolescence.

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Defense Profits Will be Linked To Contractors' Performance

Washington—Profits resulting from cost reimbursement type defense contracts in the future will be tied to contractor performance, risk taken and amount of private investment in property, equipment and labor.

Change 3-8881 to the Armed Services Procurement Regulation (ASPR) which became effective last month, augments weight to a number of policies that could result in a contractor's making a gross profit of as much as 10% or even result in a loss of 25%.

Post Performance

In addition, post performance pay will be taken into account in determining profits. This involves evaluating the performance of defense contractors, a procedure which was initiated at Defense. Directive 5715.35 of Aug. 1, 1961, pursuant to studies at that time the selection of contract winners (AVW Aug. 12, 1961).

Under the ASPR, a contracting officer administering a contract which is based on the basis of cost analysis, will be required to:

- Establish a profit objective which will permit the contractor to earn profits in proportion to the amount of risk it bears in willing to take. The greater the risk, the greater the profit.

- Reward a contractor who provides him with facilities and financing so he can establish competence through prior development work independent of his own risk.

- Establish responsible for establishing ASPR policies and the current 1% average profit on defense contracts is 2%.

Because for the high speed attack missions All but one will be savings during the 1960s. The ships of this class, displacing over 30,000 tons each in the attack carrier category, are the Bon Homme Richard, the Hancock, the Lexington, the Shangha-Lu and the Ticonderoga.

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low and should be used to provide greater incentive for efficient work, thus reducing over-all defense contract costs.

When they were asked whether the Reimbursement Act, which goes along with the idea of higher profits, the Defense Dept. officials could make out that they had been assured by the board that it would not result in defense objectives. There was no assurance given that in the future the board would not change with profits allowed in the Defense Dept. and order reduction of excess profits.

The ASPR will not apply to sole-source negotiations, personal or professional contracts, management contracts for operation of government-owned facilities, contracts with non-profit organizations where less is involved or to termination agreements.

Revised Percentage

Suggested revised percentages for types of contracts are emphasized for fee, 0.1%; cost plus incentive fee, 1.2%; cost-plus-incentive-risk including cost performance and delivery incentives, 1.5-2%; fixed-price-incentive including cost or delivery only, 2.0%; fixed price-incentive including cost, performance and delivery incentives, 4.0%; progressive price reimbursement, 4.5%; fixed-fee, 5.0%.

- Reward a contractor who provides him with facilities and financing so he can establish competence through prior development work independent of his own risk.

- Officials responsible for establishing ASPR policies and the current 1% average profit on defense contracts is 2%.

AVIATION WEEK & SPACE TECHNOLOGY, August 19, 1965

Kennedy Names Black as Advisor On Supersonic Transport Program

Washington—President Kennedy last week named former World Bank Dir. Gen. Eugene A. Black, who spent four years in Africa, to advise him in the development of a U.S. supersonic transport.

At the same time, Federal Aviation Agency was invited to propose to refine and expand its basic design which is faster than Mach 2.5, carries a 30,000-lb load and has a range of at least 4,000 mi. Debutus for submission of the proposal is Jan. 14.

Black, 56, has been taking "a sabbatical" from his job as president of the World Bank since July 1964. He has been traveling extensively, including visits to India and private sessions to accelerate the U.S. project. He married Stanley del Olmote, head chairman of Oberlin Mathews Chemical Corp. at Black's debut.

The FAA invited the proposals will include design, fabrication and test of a prototype. The agency will receive for 12 months, after which it will receive cost account will sufficient from the program. The first test flight is scheduled for early 1967.

Debutus had to keep the proposals

well below \$100 million to be considered to fit airplane and a single engine type. If not, he said he would be forced to live the design details to include new aircraft models and two engine types.

Determination of aircraft configuration, engine type and airframe size will be left to the manufacturers and the airlines. Debutus believes he can propose an aircraft that will carry between 125 and 160 passengers plus 5,000 lb of cargo. He estimated that engine thrust will be in the neighborhood of 40,000 lb at engine.

Debutus expressed doubts that the British-French Concorde supersonic transport (AVW July 15, p. 58) will be ready for flight testing by 1966. He and TSOI appeared to be in more than a stalemate and said that even then, substantial trials will be necessary in testing the safety factor and profitability of the aircraft before it can be put into production before it is placed into production.

He said the FAA has an idea of the proposed speed of the Concorde but said the U.S. aircraft should be faster than Mach 2.2 and should be constructed at altitude and transonic speed. He and the plane must handle as much as a subsonic transport and will have a range of at least 4,000 mi.

The U.S. plane must also be capable of flying a profit for the airlines in domestic service, he said. "We do not wish to pack the airlines back into subsonic," he said. But he noted that the U.S. SST probably will cost more to build than the Concorde.

He said the U.S. manufacturers had been successful in producing long-range jets and adequate all-cargo aircraft, but "we don't wish with the emphasis to meet the demand" for short-range jet aircraft.

News Digest

14. Gen. William W. Dick Jr., commander of the Army Materiel Command in Fort Belvoir, Va., will replace Lt. Gen. Dwight D. Sorenson as Army chief of research and development as Aug. 26. Gen. Sorenson will become Commander of the Army Cavalry Division. Col. George C. DeLoach will be relieved by Lt. Gen. Charles R. Duff who is presently Comptroller of the Army.

Douglas 5-1 flight stage for the first space successfully completed a full day test flight on Aug. 18. Flying more than 700 mi on Aug. 17, the first flight, a two-stage, was cut short at 1.36 sec due to an erroneous fuel reading (AVW Aug. 12, p. 27) transmitted by an over-sensitive test stand temperature detector. The first test flight is scheduled for early 1967.

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High-altitude flight on the Army geodetic satellite which has been operating since last spring has turned back, Avco Applied Physics Laboratory said last week. The satellite was launched last Oct. 24.

AVIATION WEEK & SPACE TECHNOLOGY, August 19, 1965

CAB Urges Local Service Subsidy Cuts

Report to White House proposes one-third reduction in five years; carriers' size ambitions are criticized.

By Robert H. Cook

Washington.—Rejection of the local service airline subsidy bill is at least one third over the next five years was recommended last week by the Civil Aeronautics Board in a highly critical analysis of the industry presented to the White House. The subsidies are now costing more than \$60 million a year.

Most thrust of the report, proposed in compliance with President Kennedy's transportation message to Congress last year, is that while the industry has done a good job in controlling costs, its rising subsidy bill reflects the ambitions of more localities to achieve their own status as "green route" operators.

Secretary of Commerce Lester Hirschman, who was invited by the Board's special committee composed of representatives of the Federal Aviation Agency, the Bureau of the Budget, and the Council of Economic Advisors, will review the report and make recommendations for any necessary administrative or legislative action.

The report put the industry on notice that CAB feels the time has come for the local service airlines and the government to "rethink the future of growth and underservice." Subsidies would have to be cut to control traffic in areas where CAB is partly or fully controlled by Board-appointed or route extension and no-expense-per-gross, the report said.

Report Critical

At the same time, the report outlined much of the industry's flight equipment program for taking on most aircraft needs of the airline routes or providing service to areas not yet served by a vehicle operator. The proposal is to add the DC-3, which still provides much half the local service airline, will receive the most extensive benefit from the viewpoint of needed subsidy support, and there seems little chance that it will be replaced within the next five years.

The Board proposed to continue its massive effort in the search for the lowest cost replacement, but refused to join the subsidy reduction plan while the search goes on. Noting that the western plan to expand airline new seating to 40 percent of local service airline people concerned about the cost which is literally orders over the industry's short-haul rates, the report also argued any move by the industry to compound that problem by ordering larger and higher jet equipment.

present 42.3% average to about 45% and by "judicious management, placing capacity cuts where needed" the added expense of handling this new traffic should require only one-half of the additional revenue, the report said.

Flight frequency, it appears, was singled out for particular scrutiny by the Board, which gave clear warning that it intended to review local service segments of the industry.

While there is "an enormous potential" of the local service industry in providing sufficient flights to small and medium towns much of the industry has "gone far beyond this," the report said. It cited the example of Chicago-Milwaukee, which received 29 direct, round-trip local service flights in each of last summer. In the same period, New York-Albany received 12 round trips; Ft. Worth-Dallas 10 trips and Rochester-Buffalo 8 trips. A total of 49 other cities "population markets" received from 5 to 10 daily round trips.

Market Survey

Surveying the overall local service market, the board recommended that subsidy be provided for two daily round trips from small and medium communities to large traffic centers plus three more fourth trips if lower subsidy rates no longer market them. Air schedules beyond those would be paid for entirely by the airline customer and 25% by subsidy.

In the present "green route" network, CAB will introduce a minimum of eight round trips a day per route. The levels will be revised so that between seven trips a day because not two hours the first run, for a day the second run and four by the third run. That would reduce subsidy by a total of \$6.6 million a year.

As the Board forms a network of frequencies in most of the high density traffic areas to insure a minimum of two daily round trips a day at 40 percent smaller local service airline passengers. Additional subsidy of \$3.8 million a year will be required for this purpose and it will be included in the "green route" revision.

• CAB currently has about 120 routes available to adopt the "use it or lose it" regulation and expects that only one third of these routes which fail to generate less than 100 passengers a day will be eliminated from the local service center. Subsidy saving here would be about \$4.4 million a year, or \$2 million during the five-year reduction plan.

• Consideration of airline services to two or more cities in one area are kept on a separate part of the reduction schedule. CAB estimates that local service operations can be transferred from 67 airports, 23 of which may be allowed by the "use it or lose it" provisions. Of the remaining 44, 10 can be discontinued in each of the first two years and the balance in the last three years. Cost studies indicate a net annual subsidy savings of more than \$30,000 a year. Total subsidy savings in the five-year span would represent \$56 million.

• CAB urges the White House to request over more sophisticated standards to use when assessing the need for subsidies. The report states that the speed and capacity of many more modern aircraft are of little value to the local service airline, the report expressed doubt that the industry will find any replacement more economical than the DC-3 in the near future. Tom often, comparisons between aircraft types are made without regard to depreciation by including the cost of a return to ownership and for dismantling. As such, the report concluded that aircraft without attracting new traffic from rural transportation in effect the reduced yield. If this is occurring, it is recommended that an aircraft's useful life be extended to 20 years.

The Board emphasized the importance of avoiding the increased cost of operations without raising the price of its product, but expressed doubt whether the local operation could continue to do so. By the third year of the subsidy reduction program, unit costs of the carrier's own aircraft in each of 28 cities would increase by an estimated 20 percent. CAB would expect that 75% of this cost increase would be paid by the airline customer and 25% by subsidy.

If this happens, the report said, the extra subsidy required would amount to \$1 million in the third year, \$2 million in the fourth and \$3 million in the fifth year.

Industry probe is being replaced soon by half of the DC-3 fleet with faster and larger equipment and th-

Family Fare Plan Producing Shift To First Class as Traffic Climbs

Washington—U.S. domestic traffic has now reported to show a 10% traffic increase for 1963 but a trend toward the lowest family fare plan though it is causing a new desire for first-class seats to prevent a continuing rate increase.

Continental Airlines for the two months after mid-June's strike, since Eastern Air Lines suspended operations between June 23 and July 22, lost nearly an all-paid day, as compared to the first-class fare plan to take advantage of the longer run. Under the plan a passenger holding a first-class ticket can take his wife and children or his family at half-fare, the combined cost being less than the cost of an equal number of tourist seats.

"While the family plan has helped fit the family situation, a low reduced all-paid tariff, that indicates that the lowest traffic flow is not of the lowest fare structure. In effect, the airline, which has sought to expand the ratio between first-class and tourist fare by raising tourist fares, is reducing that usage by cutting first-class fares.

• The results of the family plan are dramatic. In recent traffic statistics has been a decided emergence of first-class ticket holders. For the past few years, low-fare tickets in passenger class have decreased steadily as passengers showed a growing preference for the low-cost tourist seat. Even the economy passenger rate has been forced to make the switch to high business

coach or tourist level fares. For example, American Airlines reported a jump from 45% to 57% in first-class load factors and a decline in coach load factors from 64% to 60%. Load factors reported by United Air Lines for July showed an eight point increase in first-class load factors and a six point drop in coach load factors.

The trend is visible throughout the industry. If it is not early to determine what the long-term trend in domestic traffic will be, the much weaker airfield lower revenue-producing segment of the market without attracting new traffic from rural transportation in effect the reduced yield. If this is occurring, it is recommended that an aircraft's useful life be extended to 20 years.

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Meanwhile, there are no signs that coach business is beginning to suffer as a result of the decrease in first-class. In fact, results show 21% against a 10% increase in first-class fares. Second-class fares, however, probably a 20% decrease, to some remained soaring on first-class, undoubtedly are showing any decline in the volume of coach traffic but such traffic also results in a low fixed per-unit rate. If such traffic is filling slots that might otherwise be empty, the airline gains. If it is regular traffic, taking advantage of lower fares, revenues will be depressed.

Total revenue passenger miles for the industry increased 10% in 1962, compared with the same month last year. Assuming that Eastern had lost substantial regional operations during these two months in 1962, it can safely be assumed that traffic revenue would have been about 13% up in July and about 4% in June of this year, compared with these 1961 figures.

There are no signs of great gain of the average 75% monthly increase recorded during the first six months of 1962. The reason, the airline, which has sought to expand the ratio between first-class and tourist fare by raising tourist fares, is reducing that usage by cutting first-class fares.

In fact, revenue passenger miles



JET AIR FREIGHTER. New Boeing cargo jet, now in service, makes the *AirForce* a nuclear cargo distribution system built around air freight generate so many savings — in inventory, warehousing, crating and ground-handling expenses — that over-all costs are reduced. Shippers in hours instead of weeks

improve competitive sales position and speed capital turnover. Boeing cargo jets carry larger payloads at lower ton-mile costs than any other commercial transport. New flying with Pan American, Northwest Orient and World Airways, Boeing cargo jets enter under union with American, TWA and Pan Am.

Capability has many faces at Boeing



MICRO-ELECTRONICS Micro-electronic research is one of many advanced technologies that benefit electronics avionics, which provide electronic systems for ballistic missiles and space vehicles.



SATURN V, drawing, right, will stand tall as a memory building and long life lesson in work and teamwork. It is the largest and most powerful rocket ever built. It is the first stage of the space shuttle for NASA's SMC program, launching with thrust of approximately 100,000,000 pounds-force.



U.S. AIR FORCE Maintenance, using Boeing's unique recovery procedures, has delivered more than 100 aircraft since they took only four-day average supply. Boeing space research includes propulsive control, orbital docking and life support systems.

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American, TWA to Swap Engine Overhaul

New York-American Airlines and Trans World Airlines have reached a formal agreement to swap engine overhauls that extends to many flight components a trend that began with joint parts inventory programs and ground-handling equipment.

TWA will overhaul Pratt & Whitney JTBD turbolines engines for American's 27 Boeing 727 three-engine transports on order as well as its own 727 engines at its Kansas City overhaul base.

American, in turn, will overhaul General Electric CJ805-1 engines powering TWA's 26 Convair 880s at its Tulsa overhaul base. Toulouse CJ805-21 engines, being overhauled by American's Convair 990s are being overhauled on a line set up there, but TWA has had its CJ805 overhauled carried out by GE at GE's Chicago, Calif., plant because of lack of space at Kansas City.

Overhauled engine packages will be waiting at each point for certification. Generally American's JTBDs will go back to American engineers and TWA JTBDs to TWA engineers, but permission is made for tandem packing. American will be overhauling some TWA engines, while TWA will overhaul American JTBDs, but TWA has a JTBD base of 2,500 hr. Turn-around times at both bases have been established for the JTBD but it is expected to begin at 1,000 to 1,200 hr.

Each airline will bill the other for work performed on less worked out equipment.

The agreement is significant even if it only helps an airline if it can't make some gains in this area," P. G. White, American Airlines vice president for maintenance and engineering, commented.

The stipulated license does not just entail a partnership for further maintenance, but also for technical support for individual exchanges are limited. However, TWA is taking advantage of TWD's overhaul stock from surface ashoring the 727 or the Douglas DC-9.

American overhauls CJ805-1B and -2B engines pursuant to Federal Aviation Administration Agency Contract 883 and 990 respectively.

American regards the plan as an important demonstration of the concept of it would cost no more than its in-house program.

Stakeholders should find the number being passed on interesting for their overall especially appealing. What believe?

Precious efforts of this kind, such as American's system, in which Alvin Dry of General Motors handled over half of American's Electric engines, did not meet expectations. Worse was he to leave the essential element a fact that work must be handled by inferior people for future people.

Another essential element in the confidence factor. No maintenance can be given to the engine. Other than a few basic procedures, no American employee will be based at Kansas City or in TWA's plants at Tulsa. Each airline is relying on the other to perform its work in exchange engines as if they were their own. The agreement does provide for exchange of analysis, analysis, and complete engine performance and overhaul records.

TWA will measure its 550 engines at Kansas City, then the power package goes to the appropriate engine in the overall system, to track it to Tulsa for overhaul. American will do the same with its 727 engines of Chicago.

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To help expand work loads further, American will outfit overhaul the last engine for TWA, but TWA will get the entire engine and accessories from

American's 727s. Some exceptions are provided, however, in cases where specialized capability exists. American will handle turbofan overhauls for TWA, and it will also continue to handle its own conventional drive work for the JTBD, until this time will be generally standard with American's Boeing 707 series engines.

First TWA engines will not go to Tulsa until February to permit an early phase out of the contract with GE. TWA will begin support of American's JTBD engine operation eventually with support of planning and analysis procedures. American's 727s will enter service next spring.

During the first year of the five-year agreement, American will do twice the engine work for TWA that TWA will do for American. American's work load will be greater the second year. But by the third year the work loads will balance.

American will add about 70 employees at Tulsa to handle extra work during the first year of the agreement. Eventually effect will be to eliminate cross-training in both bases, rather than increase or decrease it.

R. M. Davis, TWA vice president for technical services and an early advocate of space pooling, negotiated the agreement. In TWA discussions with White, for American had begun more than a year ago, but final action on the plan was stalled by American's application to merge with Eastern Air Lines.

Court Upholds Allied Pilots Pact

New York—Right of the Allied Pilots Association to break away from the Air Line Pilots Assn. and sign its own contract with American Airlines was upheld last in a federal district court decision last week.

Judge Isaac B. Wyzn of the Southern District Court of New York ruled against ALPA that the union's right to sign separate contracts with American Airlines was upheld last in a federal district court decision last week.

ALPA argued that the union's right to sign separate contracts with American Airlines was violated by the Air Line Pilots Assn. (ALPA) contract, which prohibited it from, not ALPA, was the union name being sought for American's pilots.

Heian, White, counsel for ALPA, has appealed the decision. A hearing on the appeal will be held Sept. 5 before a three-judge panel in the Second Circuit U.S. Court of Appeals here.

"To give the ALPA national recognition, controlled by employees of other airlines, a vital power over contracts negotiated by the American pilots, who want work under the contract, is not consistent with democratic procedure," Judge Wyzn said.

However, Judge Wyzn issued a companion decision upholding a suit brought by the Flight Engineers International Union, which establishes that union's rights to represent American's flight engineers.

Shortly after Judge Wyzn's decision, Adolf Schwartz, counsel for the flight engineers, presented the union's case to the union demands to American. The committee, which is a bargaining group, is asking \$15 million for the engineers to receive their increased and automatic pay raises.

American has said repeatedly that it will not pay for such training. But the engineers consider the pilot pay adjustment, particularly since other carriers, such as Trans World Airlines and Eastern Air Lines, have agreed to pay such costs and the PEA wants all in manner equally qualified.

American's engineers also want their contract to treat them permanent right to the engineer's slot, a job security provision.



BAC 111 Maiden Flight Scheduled

First British Aircraft Corp. BAC 111 freighter, checkered livery, scheduled to make its first flight this week at Victoria-Abbotsford, B.C., Canada. First assembly plant, carries 6,000 lb. of freight, test equipment and Smiths Avionics landing system. The aircraft is painted in British United Airways markings but is owned by BAC. First BUA inspection No. 2 on the line and will be rolled out in five weeks. Engine ratings on the Rolls-Royce Tyne 11 passengiers were being completed last week, with only minor running adjustments being made. First batch of BUA aircraft will use the 11, which produces 18,000 lb. thrust. Later aircraft will use the 3 version, producing 10,400 lb.



This Week Following Engine Tests

First BAC 111s for American Airlines will have the more powerful Spey 21 engines (AVW July 22, p. 335), now under development by Rolls with British government aid. Rolls-Royce has completed seven 150-hr test runs to meet US Registration Board Federal Aviation Agency specifications. Front view (top, left page) shows main wing slat dive position. Rear view (top, right page) shows the aircraft during stops at trailing edge and refit for television aerials, power unit mounted in tail cone. Unit provides power for main engine starting, ground electrical power and ground cooling of engine and passenger cabin. For additional photos, see p. 45.





Which exhaust valve is the real bargain?

The exhaust valve on the right was sold at economy prices as a new part for Pratt & Whitney Aircraft's H-2800 engine.

Superficially, it resembles the genuine Pratt & Whitney Aircraft original equipment part at left. But laboratory tests show that it has been re-worked. The stem tip has been replaced with material which is less than half the specified hardness. Material has been added to the entire stem to compensate for wear and pitting.

Compromising quality for the sake of saving may be justified in some things—but never in aircraft parts. Engine operation quickly reveals

weak components and the result may be both serious and costly.

The key to genuine engine economy is long-term component reliability. The best way to ensure that dependability is to always specify Pratt & Whitney Aircraft original equipment parts. They are quickly available direct from Pratt & Whitney Aircraft or from its authorized distributors throughout the United States and Canada.

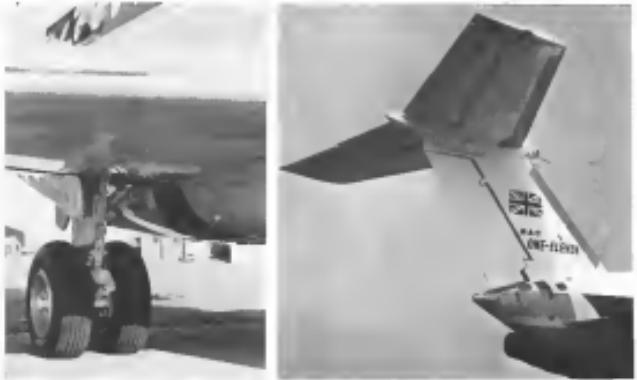


Pratt & Whitney Aircraft parts meet price.

Pratt & Whitney Aircraft
East Hartford, Connecticut
United Aircraft of Canada Limited
Longueuil, P.Q., Canada



Kelly-Kane Spey I engine on BAC 111 is housed in pod (left), developed by Kelly, which is double-bagged for easy maintenance work. Pod will remain luminescent the same when Spey 21 horsepower are installed in later models. Engine can be removed for overhaul in 1 hr 15 min. BAC 111's single retracting point (right) pod shield of eight-way mast provides fast entry at rate of 30 ft/min.



Twin-wheel landing gear (left) was designed by Vickers Armstrongs and extends sideways into center fairing. Design includes protection to free fall in emergencies. Nose wheel retracts forward into nose section. Tail section (right) shows landing gear Vickers VC.10 expression and is powered by a scaled version of the VC.10 design. Elevators are manually controlled by spring tabs and one-piece rubber is hydraulically controlled by main operating pistons installed at the base of the tail section.

Airline Traffic—May 1963

	Revenue Miles (Miles)	Passenger Passenger Miles (Miles)	Revenue Passenger Miles (Miles)	Total Revenue Tons Miles (Miles)	Average Overall Load (Tons)	Subsidized Miles (Miles)	Performance Factor (Tons)
DOMESTIC TRAVEL							
American	10,714	274,3	446,304	36,0	73,802	4,47	10,93
Basell	3,476	214,8	10,9	8,5	10,642	4,26	9,9
Continental	2,314	136,3	9,5,243	43,7	10,326	4,13	2,123
Delta	2,024	204,4	234,3	60,8	27,244	6,10	1,596
Eastern	8,122	204,4	234,3	60,8	27,244	6,10	1,596
National	2,721	172,7	128,813	64,9	16,311	2,31	2,313
Pan American	7,382	120,6	45,721	68,5	4,746	3,39	1,128
Trans World	8,243	441,2	116,534	69,3	49,720	4,95	8,508
United	16,445	1,059,3	673,723	68,4	9,687	3,12	1,427
Western	2,317	203,7	107,249	64,8	11,351	3,04	3,259
Domestic Total	63,618	4,416,4	2,994,326	68,6	249,812	3,12	64,208
INTERNATIONAL							
American	134	8,3	2,240	61,4	1,022	6,44	10,0
Basell	361	2,0	10,381	19,8	1,079	5,14	9,9
Continental	124	47,4	3,575	19,8	1,079	5,14	9,6
Delta	1,024	4,7	4,746	19,8	1,079	5,14	9,6
Eastern	1,039	45,9	1,750	45,4	8,193	4,15	1,789
National	1,759	8,7	2,032	45,4	203	2,62	1,789
Pan American	224	30,6	40,397	13,3	6,176	8,70	1024
Trans World	111	1,2	11,790	11,7	1,079	5,14	9,6
United	7,947	212,7	60,027	19,8	81,194	9,22	7,009
Non-American	111	0,2	546	64,4	203	5,31	11,00
South Pacific	111	0,2	546	64,4	203	5,31	11,00
Trans-Caribbean	273	12,9	12,880	38,3	2,074	9,22	104
Trans-Middle East	581	12,9	10,820	44,3	2,074	9,22	104
World Total	199	7,0	40,820	64,3	3,213	9,44	1,887
International Total	16,163	387,3	1,291,199	22,3	938,923	8,33	13,214
LOCAL SERVICE							
Air Force	102	92,7	18,410	42,2	3,012	2,83	93,8
Alaska	276	43,3	10,507	64,4	1,079	5,14	9,6
Central	631	93,2	6,211	37,6	204	1,12	130
Far East	519	40,2	10,817	38,6	7,102	1,33	97,9
Latin America	1,258	101,7	22,678	47,1	2,186	2,08	1,267
Midwest	1,208	99,6	16,575	38,6	1,741	1,40	1,264
North Central	897	67,9	12,812	68,3	1,349	1,32	100,8
North	897	42,5	10,817	38,6	1,349	1,32	100,8
Philippines	170	76,4	14,730	44,3	1,679	7,79	927
Southeast Asia	872	63,2	9,338	23,3	919	1,12	603
Trans-Tasman	493	36,0	9,330	39,5	988	1,26	104
West Coast	1,204	24,2	1,204	39,5	827	1,21	110
Local Service Total	10,024	491,0	146,943	75,1	16,329	1,56	10,293
ALASKA & HAWAIIAN							
Alaska Airlines	216	0,1	4,165	22,2	1,418	4,12	156
Alaska Central	162	10,9	1,011	50,1	808	6,71	19,9
Alaska West	199	27,7	1,011	50,1	247	1,15	119
Connair	89	3,0	4,044	31,3	84	0,96	55
Hawaiian	206	41,1	8,167	53,9	670	2,44	201
Interstate	571	1,2	1,204	39,5	242	0,22	20
No. Consolidated	207	1,6	12,646	15,1	1,744	5,59	312
Pacific Northwest	156	2,6	1,492	28,8	244	2,48	88,3
Seattle Alaska	207	0,8	1,028	50,1	84	0,17	77
West Alaska	316	4,1	1,210	24,4	326	1,20	116
Alaska & Hawaiian Total	2,049	115,8	33,194	39,3	1,311	3,78	1,119
INTERCARRIERS							
Chicago	30	8,8	156	42,2	12	0,42	39,3
Los Angeles	70	13,2	807	45,1	64	0,92	71
New York	44	30,9	416	47,3	31	1,10	44
Intercarrier Total	1,044	68,8	1,995	47,1	1,027	0,87	116
CARGO & OTHERS							
Alaska	24	8,3	307	70,4	31	0,84	38
Big Four	1,249	8,7	2,014	64	81,624	10,3	234
Britis	1,2	1,2	1,129	74,4	1,129	4,74	54,7
Continental	278	2,2	20,441	97,8	9,916	17,18	238
Delta	619	5,5	1,750	39,5	8,702	10,84	101
Cargo & Others Total	3,526	36,6	48,331	97,1	40,388	10,81	1,274
Subsidy Total	84,285	4,109,9	4,144,982	39,9	1,047,340	0,19	12,743

Prepared by Ray & Roy

BEA Chairman Urges Parliament To Reject BOAC Merger Idea

LONDON—Airline management fight to keep the two British state-owned carriers separate ends with the letter sent last week when Lord Douglas of Kirkton, chairman of British European Airways, wrote 10 members of Parliament urging them not to support a merger with British Overseas Airways Corp.

Douglas' letter lends weight to speculation that the influential Cabinet Minister will recommend a merger or, at least, a joint management board (AW 10 p. 40).

In a memorandum accompanying the letter, Douglas said that, in the event of a merger, "staff morale would suffer enormously." BEA is expected to show a revised profit when its accounts are made public next week, as the other hand BOAC probably will report another large loss.

Points Examined

Points made to the MPs by Douglas include:

- Major mergers would be very large with about 35,000 employees. BEA now employs 16,000 and BOAC 22,000.
- Merged airline with two separate identities, short and long-haul, would be difficult to control in one board and one management who could not divide enough time and attention to the two totally different problems of each.

• Traffic carried by a merged BEA-BOAC from the U.S. to the Continent would not increase substantially if they operated through services. Douglas added: "People who travel between the U.S. and the Continent and passengers don't like an intermediate stop at London under this stop-over in Canada, which is a through service to no advantage."

• Loss of revenue revenue world-wide, probably in dollars, because BEA is not a North Atlantic competitor. The BEA chairman told the MPs that one way to avoid this would be round a direct flight to New York via Paris.

Douglas also cited strong differences of opinion on the fare level and the type and quantity of promotional fares which should be adopted.

No airline appeared willing to cut fares to the level proposed recently by Pan American, which has in turn faced a blow-off (AW 10 p. 42).

One major proposal complicated by the tariff situation while action postponed broadening of promotional fare plan.

Initial reports are generally agreeing less at this time and serve only as a basis of continuing negotiations which will be elicited by the formal meeting of the International Air Transport Association Conference beginning Sept. 3 at Salzburg, Austria.

the other as labor and wage policies. Another argument against merger, however, is that private owners of BEA seats are never likely to be sold out to offset the losses from BEAG operation if the airline's present rate of loss continues. A revised compensation thus would be likely to have a deficit in long as BEAG has a loss, he concluded.

Douglas pointed out that BEA's losses have been due in large part to "its failure in its function, and to a certain extent to be reflected in its present way of operating as a state-owned concern." He continued:

Commercial Basis

"If BEA is to conduct its affairs on a proper commercial basis, it must be left to do so. Only other considerations such as a requirement for BEA to do so, as far as something because of the effect on BOAC, are allowed to come in, the minister to run the business profitably begins to die."

Meanwhile, BEA plans this week to begin a nationwide strike ballot as a dispute with management over pay rates to Cabin and Technical employees. The vote involves a massive system of allowances.

The Cobitt Report, or at least portions selected by Minister of Aviation Julian Attlee, will be presented to Parliament this fall in a White Paper on air transport.

Flag Carriers Favor Lower Atlantic Fares

Washington—Five aviation reports of international flag carriers on a transatlantic fare structure filed with the Civil Aeronautics Board last week show a decided trend toward lower fares.

Reports also reveal strong differences of opinion on the fare level and the type and quantity of promotional fares which should be adopted.

No airline appeared willing to cut fares to the level proposed recently by Pan American, which has in turn faced a blow-off (AW 10 p. 42). For several carriers, unusual airfare diversions are quickly arranged. Where in the world do you ship off Air France's world's largest airline, serves the area between Europe and North Africa? Well, you can fly on Air France's cargo division. Or take Air France cargo service office.

AIR FRANCE CARGO
MONTE CARLO AIRPORT
WORLD WIDE CARGO SERVICE



**For the frozen frontiers:
a family of steels to which zero means nothing**

Strange things happen in the world of ultracold. Some metals get stronger but sometimes so brittle they shatter like glass. Others become superconductors. The load-carrying capacity of some fluctuates wildly. Material selection, in this strange Pandora's Box world, must depend on carefully accumulated performance data.



The 54-in. long aluminum coil is fabricated of 4043 aluminum plate, popular for aerospace requiring smooth low temperature strength to -200°F.

**ASTM A201 and A212:
for many years the
only low-temperature
steels available**

These ten carbon steel grades are widely used for a variety of applications requiring notch toughness down to -50°F, such as refrigerated vessels for the storage of liquid propane or ammonia.

A36K allowable design stresses (% tensile) are 15,000 psi for A36 Grade B and 17,500 psi for A572 Grade 50 steel.

Both grades are available in four-inch thicknesses. When specified to meet the impact requirements of ASTM A360 to -58F, the plates may be furnished in the annealed or normalized and stress relieved condition to meet the minimum requirements for the as-rolled condition.



LESS "T-BIT" BLOW-OUTS WHICH REQUIRE HIGH STRENGTH AND RESISTANT TO HIGH WORKING STRESSES IN LOW TEMPERATURE SERVICE



This 27% N marked with stable isotope had
shorter turnover at temperatures ranging
from -65°F to 100°F.

USS "T-1" Steel: can cut pressure vessel weight up to 50%

USS "T-1" Steel combines great strength (100,000 psi over yield strength), weight savings, and low fatigue strengths (CFS = 8.4). The dry breakoff stress is -300°F. It is particularly suited for highly stressed pressure vessels operating at temperatures down to -320°, tank trucks for handling LP gas, and welded lightweight structures.

In a series of dramatic burst tests, USR "T" Steel vessels withstand internal hydraulic pressures up to 2800 psi at about -45°F before bursting.

equivalent to 1 cushioning in stress at 180,000 psi. Another series of "T-1" vessels, refrigerated to about -65°F and pressurized to 1879 psi were tested to destruction by impact from a 13-ton mass dropped successively from 55, 75, and 100 feet. An impact energy of nearly 2,300,000 ft-lbs. was required to rupture the vessel.

**USS 2½% Nickel Steel:
down to -75F**

SiO_2 -rich melted glass has been used widely for tank vessels and piping, heatpipes, liquid propane and other liquefied gases at temperatures down to -70°F . It has been used particularly by the chemical industry for process and containment vessels. Specified sizes include containers such as static altitude tank containers, open-top tanks, vertical tanks, and tanks for storage of 70,000 lb. liquids.

27^{1/2} stacked staves is governed by AFM&R 2000, Grade A and Grade B in usual world wide use because of its efficiency and class performance of 27.800 psi compared to 26.200 psi for Grade C.

These details are also covered by
SA-303 of the ASME Boiler and Pressure Vessel Code.

ance data. We have a wealth of such data at United States Steel, plus comparative design studies, that will make your material problems easier. Ask for a USS cryogenics specialist by calling our nearest sales office, or writing United States Steel, Room 6334, 525 William Penn Place, Pittsburgh, Pennsylvania 15230.



Four measurement errors were made about 1950, originating in the 1950 census and in 1954.



20% to 30% about among general stimulants, varying other things the triple amphetamines get 8-10% to up to 15 percent and more.



Fig. 3. The phage titer and host susceptibility retains strength, stability and checks reactivation in aqueous freezing at -40°C.

USS 31% Nickel Steel:
used for land-based
facilities and
ocean-going tankers

Low carbon 2345 steel has been used for lead-based facilities for the containment of liquid propane, carbon dioxide, acetylene, ethane, ethylene and other liquefied gases at temperatures down to -175°F . Its excellent low-temperature toughness makes it suitable for use in shipboard tanks to transport liquid ethylene. Its flammability, when oxidized, has resulted in its use for tanks, vessels, piping, valves, fittings, hoses, and many other components.

34Cr₂N steel used is covered by ASTM A203 Grades D and E. Allowable design stresses are 16,250 psi and 13,500 psi, respectively. These steels are covered under ASME-2003, ASME Boiler and Pressure Vessel Code.

The ASME allowable working stress of 20,000 psi (Code Case 1308) is considerably less than that of 15,000 psi per recommended practice for the aluminum alloy 5055 O. These thick-walled sleeves can be reduced to less than half the size of aluminum with similar reduce from a cost per square foot.



United States Steel

AIRLINE OBSERVER

► Continuing U.S. difficulties from foreign flag carriers to U.S. airlines on North Atlantic routes (AW June 3, p. 36) is creating a serious overcapacity problem for a number of flag carriers. Both Pan American and TWA are reporting substantial gains for the number of passengers carried on the route during the first six months of the year. Pan Am and the share of the market have increased by 12% in this period, while TWA's increase has been slightly higher, up 16%. Over the same period last year, the total traffic carried by the U.S. airlines on the North Atlantic routes was only 49%. The improvements can be found in the big jump in capacity. Available seats in the first half of the year for all routes climbed 17% and the number of flights increased 13%. The overall load factor for the 18 airlines in the North Atlantic dropped five points to a low 45%.

► Looking at U.S. government agencies that control the development of a supersonic transport continues to delay the start of a definitive program. Both National Aeronautics and Space Administration and the Federal Aviation Agency are examining cautiously the requirements. Last month, the Aeronautical Systems Div. of the Air Force Systems Command was loan establishing a supersonic transport project office. There were eight candidates for director, seven of them general officers. Last week, however, the effort was abruptly halted, suggesting that the Air Force project may have ended with the program under way at FFAA.

► Alfred R. Sturt, head of the Civil Aeronautics Board Route Div., is slated to attend the International Air Transport Assn. Traffic Conference in Salzburg, Austria, as official U.S. shadow of president (AW July 29, p. 36).

► British Overseas Airways Corp., taking a cue from the other nationally owned airline, British European Airways, has applied for permission to add 100 daily seats on the London-Manchester and London-Glasgow routes in an attempt to fill empty seats. BEA claims an extra 80 passengers a day are affected by the shoulder arrangements, which often leave fares 20% more than 10% less if one-third off is granted.

► Transair Europe Airlines, Ltd. (TEAL), the New Zealand national airline, will fly for its former Douglas DC-6 fleet lessees (AW Aug. 12, p. 18) through an average loan of \$25 million. F. A. Kerr, TEAL general manager, said low rates and interest savings will be passed from company resources.

► Rapid development of the Turkish Airlines 100-horsepower engine has made it possible for Skar, Dornier & Härklin to increase gross weight of Turbo-Skyserv transport to 12,500 lb. with a 4,000 lb. payload. The engine will be offered for the production Turbo-Skyserv and the prototype, now being modified, will fly with two Allison 2A engines for flight test purposes. Airbus II develops 645 cfm against 530 cfm for the Avantair 3.

► Continental Airlines is bringing up public relations doubts about the future of its airline for the Anglo-French Concorde supersonic transports. One company official said "these codes are in force in the case we placed for losing 70% and we're living them." He said published statements implying that the order for the Mach 2.2 aircraft was a political gesture "aren't worth answering." Indication of the seriousness of intent, he said, is that the \$30 million purchase has been cleared with Continental's bankers.

► Progress in air transportation is something's a relative thing. A 1970 survey shows that a shuttle service now operates every hour on the hour between Washington and New York. (Northeast) at a one-way fare of \$147.90. Eastern Air Lines current Air Shuttle rate is \$116. The 1970 service was offered by the old New York, Philadelphia and Washington Airway Corp.

► Dual procurement will be at the center soon for passenger helicopters as it replaces a dynamic in 1970 to attain contracts to Grumman Aerospace give a no-flys contract to Lockheed Helicopters. Sondrestrom Airlines System's report at Southeastern Fly-in. Dames have shown an interest in the Sikorsky S-61.

SHORTLINES

► Allegheny Airlines has reported a net income of \$61,000 on gross revenues of \$17 million for the first half of 1967. The company ends with a net margin of \$446,544 on gross revenues of \$111 million during the first six months of 1962.

► Civil Aeronautics Board has ordered Sonesta Airlines to report service on its consolidated route before next Feb. 4 at least six operating certificates. The Board found that Sonesta had discontinued service between Pago Pago, American Samoa, and Apia, Western Samoa, for a "substantial time."

► Federal Aviation Agency has issued 39 technical papers dealing with aircraft landing systems for pneumatic, hydraulic, electro-hydraulic, magnetic and Displacement Separation at Atlanta City Sept. 18 through 18. Fifteen foreign governments have indicated that will be represented at the symposium.

► Flying Tiger Line has reported a net loss of \$833,942 after a provision for a hybrid income tax credit of \$317,000 for the first six months of 1967. Gross revenues for the period were \$192.2 million, compared to \$25 million in the first half of 1965, when net income reported was \$1 million.

► Lake Central Airlines last week sent an aircraft evaluation team to France where it will study the Nord 262 four-turboprop transport (AW June 18, p. 28). Nord has proposed special write studies concerning the acceptance of the 25 passenger aircraft on Lake Central's system.

► National Airlines has shown a 30% increase in enplaned trans-traffic in the Miami market this summer in comparison with the same period last year.

► Trans World Airlines will place into service the sixth one of the six Convair 880 aircraft which it purchased from General Dynamics Corp. earlier this month (AW Aug. 12, p. 49). The planes have been on lease to Northeast Airlines but General Dynamics earlier had determined that the fleet be returned because Northeast was \$4.8 million behind on lease payments (AW June 21, p. 40).

► United Air Lines flew 1.2 million passengers 860.7 million revenue passenger miles in July. The carrier said these figures are industry records.



Multiple radiographs showing the aircraft wheel-brake casting.



Multiple radiographs show detail in both hub and disk sections.

It says "STOP" to a landing aircraft

This part for an aircraft wheel-brake, cast in magnesium alloy by The Wellman Bronze and Aluminum Co., is radiographed to show it is sound and ready for its job.

With the safety of an airplane at stake, the integrity of this casting must be proved. Also the internal passages for the pneumatic and hydraulic systems must be shown free of all foreign material.

So the Wellman Bronze and Aluminum Co. of Bay City, Mich., inspect each casting by radiography.

Two films, Kodak Industrial X-ray Film, Type A/A, and Type M are exposed at the same time. In this way, both thick and thin sections are entirely radiographed simultaneously.

Makers of castings, as well as fabricators find radiography a big factor in product integrity, in satisfying customers, in attracting new business. To find out how radiography can help you, contact an x-ray dealer or write us to have a Kodak Technical X-ray Sales Representative call.

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INDUSTRIAL

Basic Gemini ECS Keyed to 14-Day Flight

By Harold D. Watkins

Los Angeles—Environmental control systems (ECS) for the Gemini two-man spacecraft will combine state-of-the-art advances in proven Mercury concepts with new components made necessary by the more stringent mission requirements of the second generation manned space vehicle.

With few exceptions, whenever Mizaray ECS concepts were adaptable to Gemini, the change made were evolutionary rather than revolutionary. The great majority of situations were brought about by the change in the nation, which required an environmental system to operate safely for the equivalent of four man-weeks (two men for two weeks) as compared with 28 man-weeks in Mizaray.

Duplication of Mercury system design concepts is particularly evident in the life support segments—the suit and cabin loops—but extent of modifications and improvements is indicated by the fact that only two valves in the Gemini ECS are identical to hardware used in Mercury.

Essential task for the Gamma system is basically the same as for Mes-



ARTISTS RENDERING SHOWS Generic software as orbit (display attached) with interface revealing some customized control system elements. In silhouette, upper right, is a spherical device containing primary oxygen supply. Behind it to the right is a smaller module, including fuel containers and water tanks. The red rectangle which appears to move, "The larger oxygen cylinder," is the primary oxygen cylinder. The smaller cylinder is the secondary oxygen cylinder. A small blue rectangle above the cylinders is the emergency oxygen supply bottle. The clustered pressure bottles below right is one of two secondary oxygen supply bottles. Double red circles piled up are two medium oxygen bottles for each emergency oxygen extraction test system. On left bottom of screen are various components of the cable loop.

center for both aircraft. Overall supervision is provided by the Green project office of National Aeronautics and Space Administration's Manned Spacecraft Center at Houston.

Detailed regimens of the General ECG are as follows: oxygen for breathing and pronation, to remove carbon dioxide, moisture and odor from unexpected breaths, to provide for water supply management both for nose and mouth, and to furnish ventilation and temperature control for care, calm, equipment, and fuel cells.

Basic System

Basic ECS system that Adelante has designed for Gemini is for the extended 14-day scientific mission being planned. Essentially the same system, with exception of amount of expendable supplies, will be used in short missions, with the present designs based on a two-day duration.

The Gompel system, now undergoing fully manned development test chamber studies, will, like Mission, be a single oxygen atmosphere, maintained at a nominal 5.1 psi on orbit. But oxygen again will be purified by molecular exchange.

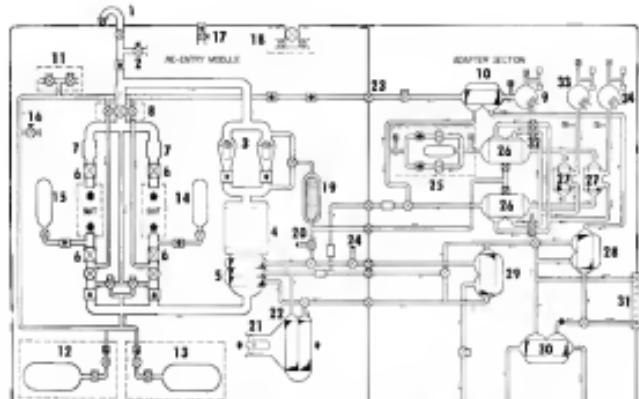
The ever-increasing design goal test metric is to be the greatest degree of assurance that no single component failure will cause either an immediate short or damage to the crew.

Due to the greater number of entries, the amount of redundant equipment in periods the safety is greater than in Mammals.

Reduced Automation

Increased confidence in man's capability as space has prompted some reduction in extent of automated controls, with a resulting increase in degree of reliability due to less complexity, according to Richard C. Nilson, Alliantek's program manager for Gemini ECS. At the same time, the system is designed to require the least possible amount of erroneous intervention.

Temperature control at Gezira is expected to be considerably less time-consuming than it was at Misirya where maintaining the small amount of water for evaporation cooling was difficult. Water management techniques and the general control level of alignments are expected to be better in Gezira than in Misirya.



Мого співочного го Солова зустрів
як в більші.

- Primary oxygen supply will be stored at supercritical pressure in a cryogenic spherical tank, rather than at a high pressure gas can storage vessel as in Mariana. Supercritical state enables a gas not liquid-presents significant savings in total tank and fuel storage weight and size.

- Primary cooling system of Goris is water in a heat transport loop through black coolant fluid (MCS-100) flows in series through ECS heat exchangers, aqueous cold plates and dual coils as a spare radiator for cooling. The MCS-100 has water coolers for cooling unit and cabin glass directly. The large amount of water is required for thermal

systems in water-cooled air blowers, which are raised out a waste hole. A total of seven heat exchangers are used for cooling and heating in the German PCS, compared with two in Mexico. Two other heat exchangers are employed in the German gas reactor supply system for fuel cells.

- An integrated heat exchanger water separator is employed instead of the separate heat exchanger and mechanically activated sludge-type water separator in Münster. The German water separator

177), dual valve passage relief valve 184, water tank
199, draining water selector valve 200, valve for 201, valve
202, heat exchanger 212, quick disconnect 213, valve to pump
214, pump package 215, fuel cell 216, heat exchanger
217, aqueous heat exchanger 218, lower cooling heat
exchanger 219, pump cooling heat exchanger 220, space valve
231, dual O.D. positive regulator 232, secondary supply
valve 233, primary supply valve 234, pressure transducer
235, pressure controller 236, secondary supply storage tank 237,
draining 238, secondary supply storage tank 239.

shaded brush
and positioned
the best ex-
periencing with
driving parts in
various groups use
either method
the task is re-
laxed considerably
and.

system has been reduced in use, instead of Gaussian oxygen used in the fuel power. Water results.

Since most nations have agreed to the use of the International Space Station as a "piggy-back" installation, Gagarin's original design is destroyed because the chosen bed character to which blankets are mounted for attacking other components

Major segments of ECS will be divided between the adapter and main modules of the spacecraft. In the adapter module, cold water system and

source for the
oxygen used
here. This pro-
duced oxygen fan-
toms to be 70,000 ft
long. Mercury do-
mestic power to
work from the

At its Ministry, the Council set up a periodic cooling, pressurization, peridiction, and water removal for gas in the gas loop. The water loop also provides cooling and pressurization.



Tubes designed from the user's viewpoint
...use them wherever reliability is essential

...use them wherever reliability is essential

What industry really counts—as it does in industrial context applications like ours, with sales system designed and tested for the job.

Each study made to date has been based on a different type of measurement. For example, some studies measured stability or resistance. If a critical parameter step is as much as 10% from the mean value, in each case performance has definitely been worsened by reduced usage experience as well as inferiority feelings.

This year after his part off "Excellent Results," says an airline official. "No trifles."

AVAILABLE FROM YOUR SYLVANIA INDUSTRIAL TUBE DISTRIBUTOR

SYLVANIA
GENERAL TELEPHONE & ELECTRONICS

does not have separate gas purification and fuel storage components.

Other functional groupings are the fresh oxygen supply (oxygen and air oxidant), the water management logic, the exhaust logic and the emergency oxygen system. The reactor supply system (RSS), for fuel cell/oxygen and hydrogen separation, cryogenic tankage and demand-type regulation—is also being supplied by AlResearch under separate contract.

Practicality of any particular system is considered essentially a matter of semantics; in general, the soil system is probably best suited for irrigation and percolation, and the water system is perhaps present easiest with the soil being a back-up.

Basic requirements of the core melt loop in orbit are to provide a nominal heat temperature of 70°F, assuming a heat metabolic load of 100 Btu/lb hr max. Nominal design pressure has been specified as 557 at the heat sink end and 697 at the heat source end. Relative humidity is designated as 90% at heat sink. Ventilation rate provided by either one or two axial fan ducts containing axial flow components is 23 in ft^3 per minute with a pressure drop across the compressor equal to 10 in. of water.

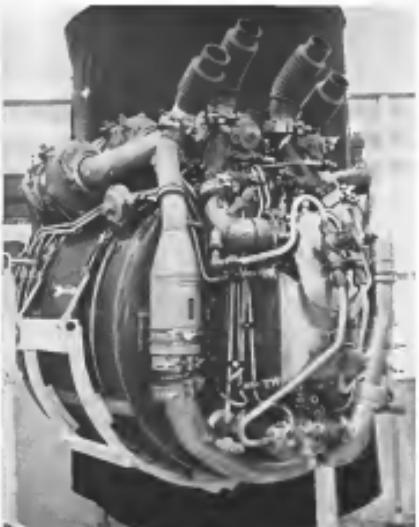
Contaminated Oxygen

Upon exit from atmosphere over the contaminated oxygen is circulated through a deion trap and then through a charcoal canister while odors are first removed by a layer of activated charcoal and carbon dioxide is removed by lithium hydroxide. Extent use of the canisters will be used for both the short and long missions, but atmospheric control will differ, with springs being used to take as slack.

A charge of 4.16 g. of charcoal and 19.6 g. of lithium hydroxide will be carbonized for two days, and 1.65 lb. and 8.1 lb., respectively, are specified on a two-week carbonizer. The aluminum content is 27.7% (calculated) and 21.79% in fact.

Purified oxygen is then cooled and dehumidified in the antisolvent heat exchanger and wick-type water separator. Water from cooled gaseous condensate in the heat exchanger line is absorbed and transferred to the water storage tank. In the process water antisolvent which contains water, ammonia, but inhibits the loss of gas. From the heat exchanger the dehumidified oxygen is returned to the crew.

Go pressure in the soft leg during the optimum orbit condition is designed to remain about 1.5 ps, while the normal orbit pressure is 5.5 ps, in order to prevent the rate of ballooning. As soft leg pressure is reduced by pressurization and decommissioning makeup oxygen is supplied on demand from two soft pressure demand oxygen tanks operating at psig.



3.2.7 LOOP SWIMMER module for General environmental control system is built around closed circuit comprising activated charcoal and lithium hydride for air purification. Hydride absorber, in addition to receiver, are four heat sink tubes of 8 mm. Two resistors each heat sink and cold coils two are from our client. Doses during operating on extreme left front in case of defects heat sink and water cooler. Two like component in order of doses causing in rapid of cameras heat sinker and water impurities. At upper left, on top of cooler, are two components. This is example of production module were being implemented in Alarisphere.

Pressure in the wet loop will follow a step up in cabin pressure until the next 39 psia, where the wet seal valve will close. This would seal off the wet loop to maintain pressure, in effect a planned or emergency cabin depressurization.

The test loop relief valve set pressure was set to 1000 psi, limiting the test pressure to 2 to 3 in. of water above column pressure. In addition, the test loop pressure will be checked to that of the column as a means to indicate that enough pressure has been added to cause though out loop to fail.

If some malfunction should prevent air from the air loop to drop to 5.5 psia, a high-atomic oxygen flow would begin automatically from either primary or a secondary supply. In this mode the oxygen flow would be approximately



Problem: duplicate this environment...

and then maintain it out here

Before America's first manned space station goes into orbit, a whole new generation of problems will have to be met and solved.

To keep the crew in good health, for instance, we'll have to maintain their Earth-like environment for months or years. We'll have to devise a supply system to get food, air, and all the other necessities up to them regularly. We'll have to keep all their equipment in operating condition. We'll have to be able to work on the outside as well as the inside of the station. We'll have to develop vehicles and techniques for shuttling personnel to and from the station, as well as for in-space rescues.

Lockheed-California foresaw the scope of these problems five years ago, and brought together a team of scientists and engineers to specialize in man-in-space. The SpaceCraft Organization has developed a high degree of capability in all aspects of space station design. They have conducted extensive studies of techniques and vehicle designs for supply, maintenance, rescue and logistics in space. Today they stand ready to undertake the many vital tasks upcoming in this challenging new age of man-in-space.

LOCKHEED-CALIFORNIA COMPANY

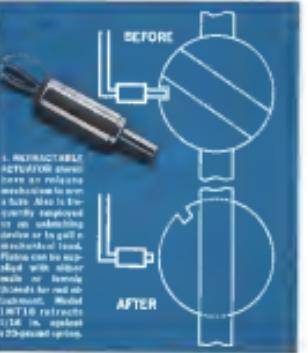
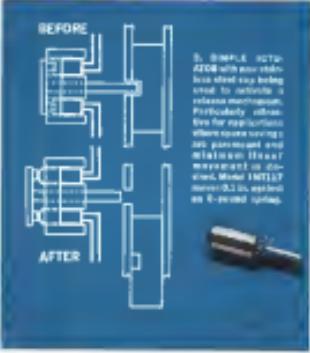
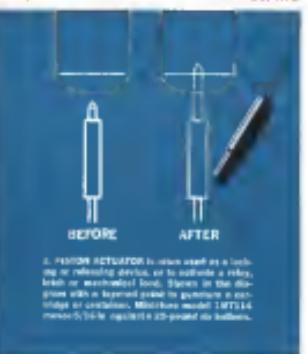
A Division of Lockheed Aircraft Corporation, Burbank, California

Four basic explosive actuators...and how to use them effectively.

Explosive devices are being used more and more widely in a variety of aerospace and ordnance applications...or whenever you need miniaturization, unmatched reliability and just one-time performance. The key to effective application lies in simplicity...you can design with a minimum of mechanical parts or electronic circuits. The four actuators illustrated are representative of many variations of explosive devices developed from Atlas Photo-Chemical-Mechanical research. We would like to work directly with you to develop the specific device that will match your requirements. Please call us on us, or send for literature.

Dept. A-8, Aerospace Components Division, Wilmington 99, Delaware

ATLAS
CHEMICAL INDUSTRIES, INC.



PROTOTYPE OF GEMINI ECS combination heat exchanger and water separator for fast refueling, with welding nutted position between exchange plates, is shown. Water does not exceed 100° Farenheit on the secondary supply line and is absorbed by porous wicking material which prevents water passage but prevents air passage. Absorbed water is transferred to storage tank. Production configuration differs from this model, although work assignment is similar.

rate and increased heat loads. Primary heat exchangers are a plastic-coated heat exchange through which gas is passed by an available valve. The loop also contains a valve set for both positive and negative pressure relief, a pressure regulator to maintain cabin pressure, and pressure valves to either dump cabin pressure or depressurize in the latter operation, oxygen is fed directly into the cabin.

Operating design points call for an orbital cabin temperature of 58°F, and cabin pressure of 10.5 psia at atmospheric pressure and capped. To build pressure to the critical point of 734 psia, heat is applied to the tank. If no thermal leakage through the tank insulation or to a baseline electric heater is used to raise all the liquid.

Above the critical pressure, the final stage homogenization occurs, described as a "supercooled" droplet suspension. During flight, pressure will be lost at 500 psia by action of the heater pressure activation by a pressure sensing switch.

With pressure maintained above critical pressure, only the gaseous state of fluid has to be handled by the system components. The cold gas leaving the primary tank is warmed by the primary tank as it passes through the heat exchanger, where maximum pressure is generated by a selected heating maximum pressure to 1,200 psia.

Downstream from the heat exchanger, a pressure regulator reduces the oxygen pressure to 132 psa for delivery into the refuel loop. The demand regulator for each seat further reduce this to the nominal 5 psa.

Supplemental pressure oxygen supply for the two-seat mixture will be 15.8 psa of usable oxygen in a 13.24 cu-in-dia sphere. For the 14-day mission, a 29.07 cu-in. carbon tank will hold 101 lb. The primary tank has an inner shell of Inconel-718 and outer shell of titanium.

The primary supply will feed into a system mixture with the secondary supply. The latter will be carried in two cylindrical tanks located in the passenger section of theovsky module. Each section of the tank is a redundant subsystem of modules connected with redundant central components assigned either to the tank or to backup if required.

Secondary tanks will each hold 6.8 lb of usable oxygen at 5,000 psa on both short and long missions; in the secondary supply function the same is both. In case of malfunction of pressure mixture each tank is capable of providing flow to passengers with sufficient oxygen for a duration of one for 40 sec at a rate of 30 min. per person.

During a refueling, oxygen is supplied at the high flow rate of 1.5 lb/min. max) for breaching, cooling and for purging out of carbon dioxide.

Oxygen flow is controlled by a

high pressure setting (110 psa) on the primary oxygen regulator than on the secondary oxygen regulator (85 psa).

When both are connected to the tank system and functioning properly, oxygen flows exclusively from the primary source. A pressure drop in primary air flow below 5 psa automatically releases oxygen from the secondary tanks.

Oxygen Tank Filled

In preparation for space flight, the supercritical pressure oxygen tank is filled with liquid oxygen at atmospheric pressure and capped. To build pressure to the critical point of 734 psia, heat is applied to the tank. If no thermal leakage through the tank insulation or to a baseline electric heater is used to raise all the liquid.

Above the critical pressure, the final stage homogenization occurs, described as a "supercooled" droplet suspension. During flight, pressure will be lost at 500 psia by action of the heater pressure activation by a pressure sensing switch.

With pressure maintained above critical pressure, only the gaseous state of fluid has to be handled by the system components. The cold gas leaving the primary tank is warmed by the primary tank as it passes through the heat exchanger, where maximum pressure is generated by a selected heating maximum pressure to 1,200 psia.

Downstream from the heat exchanger, a pressure regulator reduces the oxygen pressure to 132 psa for delivery into the refuel loop. The demand regulator for each seat further reduce this to the nominal 5 psa.

Heat transport fluid which serves the heat exchanger on Gemini, as well as the oxygen cold plate and fuel cells, will be a Monel 400 alloy ethyl fluid (MCES-15). Primary amount of heat from the coolant loop on orbit will be provided by a space radiator which

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The system is available in two packages: the DMA-29AL,

an ARINC 621 type DME system in a long, 36 ATR case; and the DMA-29A for aircraft where ARINC standardization is not required, packaged in a short, 16 ATR case. Both feature solid state switching. The DMA-29AL is also available for bridge type frequency control. Both cover all VOR/DME channels with provision for future channel splitting. Both precisely measure distance from 0 to 192 miles.

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TECHNICIANS AT AIRSEARCH test one of tomorrow's oxygen supply tanks (left) for GOMATICS at a high pressure oxygen test stand. In Gemini spacecraft a tank such as this will hold 6.5 lb. of mobile oxygen at 5,000 ps. Two such tanks will comprise the secondary oxygen supply which will be used to back up primary supplemental pressure supply. Secondary supply will also be used as an emergency backup supply if primary is exhausted. Test chamber (see lower right) to check dimensions of suspended storage tank for primary oxygen supply in Gemini ECS. Smaller of two tanks shown here, will hold 15.3 lb. of mobile oxygen.



a young heat by McDonnell as a vital part of the adapter module. Cooling of the radiator will be by liquid-cooled magnesium alloy, which will serve both as fluid conductor and structural strength. Heat will pass through the bolt and T-leg to a 190-kg/m² magnesium alloy skin surface of the adapter and will be dumped from there to radiators. There will be two one-pieced independent liquid cooling loops. In the space adapter two coolant loops will run through aluminum struts.

Location of heat-generating systems in the adapter will be in two locations. The power and color separator compensated the problem of heat dissipation. In addition, with most systems made the tubes, connection cooling by circulating oxygen cooled the equipment.

Coolant Circulated

In general, equipment outside the bus will be mounted on hollow aluminum cast plates through which the coolant will circulate.

Under normal operation, the flow of coolant will start from the space radiator at approximately 43°, powered by one pump on one coolant loop. Primary path of the coolant as the normal coolant would be from radiator through the launch water boiler heat exchanger, then to parallel flow in the cabin and seat heat exchangers, then to cold plate, fuel cells, pumps, primary oxygen heat exchanger, RSS heat exchanger, the aggregate heat exchanger, and then back into the space radiator.

Two positive-displacement gas pumps are provided for feed circulation in each loop. Selection of loops and number of pumps is controlled manually.

Magnesium cooling load in the heat transfer loop is handled, preferably, by one pump operating in each loop simultaneously. However, two pumps can also operate on a single loop for rapid cooling.

If coolant flow should cease from the space radiator before the maximum desired temperature of 48°, the fluid will automatically be circulated through the two aggregate heat exchangers in the cabin area.

Since the space radiator is sufficient both on the ground and during flight, two other heat exchange systems, also in the adapter, are employed to cool the heat-passive fluid prior to reaching orbital altitude.

Before launch, a ground heat exchanger in the spacecraft cools the ECS coolant with one MC-3-196 heat exchanger through ground loop side of the heat exchanges from a launch pad dewar.

During launch, a water boiler launch cooling heat exchanger will go into operation so the decrease in ambient temperature gradually opens a valve. Effective boiling is expected to start at 180,000 ft altitude with thermal lag expected to prevent significant heating between boiler and that point. Some pounds of water stored in the boiler's tank is expected to be consumed during the launch phase. This water boiler will

be used during peak heat loads in orbit to back up heat transfer loops, and at early service reentry to back up in case of failure of both coolant loops.

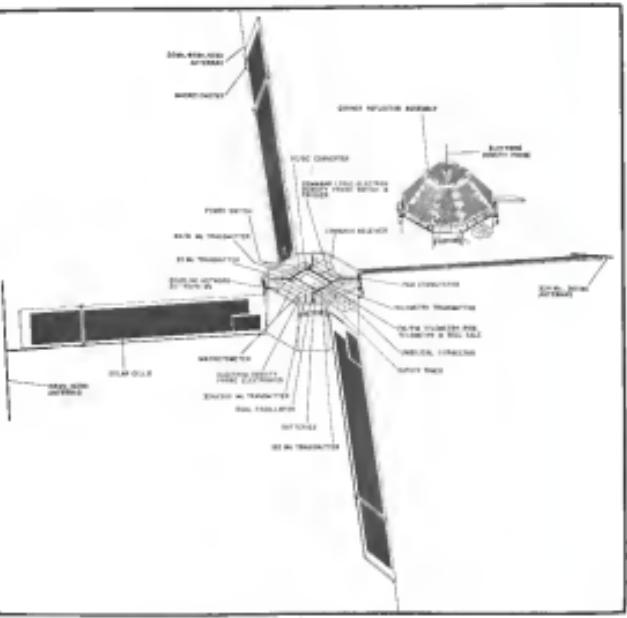
Differing in many respects from Mercury's water boiler, it will go into operation during orbit when a temperature sensing device opens a valve and releases pressure, thus causing the water in the exchanges to boil. A working material is used to allow water across the plates in the exchanges.

Makeup Water

Making water for the water boiler and for the 166° oxygen tank for crew drinking and washing will be produced by fuel cell reactors at a rate of 0.5 lb./hr. and by condensation of exhausted gas at the rate of 3 lb./min. Water from fuel cells is discharged into the 166° crew storage tank. Water from fuel cell waste receptors, however, can be manually diverted either to the water boiler or to the crew tank.

After launch, a ground heat exchanger in the spacecraft cools the ECS coolant with one MC-3-196 heat exchanger through ground loop side of the heat exchanges from a launch pad dewar. Fuel cell waste products in nature are directed to waste boiler. If that tank is full, water is dumped in a liquid waste tank until cooling is needed, in which case it would go overboard in items. If the boiler's water level should freeze in the process of dumping liquid, thereby exerting excessive pressure in boiler, an electric heating probe in the valve is usually opened on. When it is done direct to the boiler tank.

The flow of water refers to or from the crew storage tank is directed by a three-way valve, used with two pres-



S-66 Satellite Instrumentation Shown

Colony key of myxosporean bivalve, deposited 5/6 by the National Aeronautics and Space Administration, during extensive instrumentation to be used in electron density studies. Launch from Wallops Island, Va., is scheduled for September (AW Aug. 5, p. 18).

was linear, from the upstream end down stream ducts of the test loop comprising. The differential pressure rise across the compressor (10 in. of water) is used to control a diaphragm to fill or drain the tank.

The stoppers are held mechanically to the water selector valve. Should the solvent wish to leak, he turns the valve to pressurize one side of the tank bladder.

The separate oxygen life support system for short term emergency oxygen subsystem, mounted to the underside of each ejection seat and connected to respective astronaut's suit. On ejection, the astronaut automatically activates an oxygen system comprised of two cylindrical tanks, each storing 0.3 lb of

oxygen at 3,400 psi. At the same time, quick decompression releases the oxygen and gas from the out loop. The initial valve can start oxygen pressure to 3.5 psi, where ambient pressure is 1 psi.

The four German ECS systems pass through several modes of operation as the spacecraft moves from the pre-mission configuration to the final configuration at orbital insertion.

During one launch, both cabin and

During jet-booster, 100% cabin and seat bags are purged with oxygen from a ground source to reach a 100% oxygen

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calen through action of the relief valve or diaphragm regulation.

In orbit, the cabin pressure bleeds down to 5.1 psi due to leakage, where it is maintained by the cabin pressure regulator.

The armament and loop temperature is controlled by a combination of automatic and manual means. Temperature of the coolant fluid passing through the heat loop heat exchanger is controlled automatically. Rate of fluid flow is controlled manually. Each subsystem will also be able to regulate the temperature of the heat exchanger independently. A system of 6.0 cubic feet controlling the flow of cool oxygen. Temperature and flow of coolant through the cabin heat exchange has manual and automatic arrangement similar to the heat loop exchange.

During the orbital mode of operation, the ECS system is incompatible with extra atmospheric activity (EVA). The incompatibility capability, which is necessary for an EVA, is to have certain thermal insulation or plates to be provided in order to doses are free that might begin in a 100% oxygen atmosphere and to purge the cabin or suit loops of a high carbon dioxide level in toxic manner. Depressurization is accomplished by manually opening the cabin outflow valve. ECS positive oxygen supply is designed by Allis-Chalmers to prevent three decompressions during the basic flight duration.

NASA Gemini life support officials at the Marshall Spacecraft Center say that EVA is "definitely in the plan." (AW Aug. 12, p. 216). However, they have not yet established an alternative if EVA will fail to be attained. Another portable life support system will be developed for EVA, as Gemini project officials have short ruled out use of an umbilical cord attached to the space craft ECS even for backup.

Donald R. Collins, NASA space craft manager on the Gemini project, said that choices of imaging and of a pressure drop in the heat loop that would be caused by a long umbilical lead to the decision. Retraction would be in the interest of safety, he said, and would be the best way to handle the problem.

At present, NASA thinking is that only a tether line, and possibly a communication line, would be attached to an instrument venturing outside the Gemini cabin.

The early part of Gemini life support loop that would be utilized in EVA, therefore, is the sort which is being finalized by David Clark Co. Its EVA configurations are now being evaluated, and changes probably will have to be made in the course of the more detailed study of the problem outside the cabin.

The measure of confidence gained in environmental control systems from the Manned Spacecraft Center is reflected in plans for many extravehicular free-float-up operations in Gemini.

In early flights, it is anticipated that one astronaut will stay completely buttoned up, while the other wears a loose helmet and gloves. After further evaluation the status of the system is gauged, both astronauts may be permitted to take off their helmets and gloves at the same



Mariner Panel Fabrication Started

Fabrication of outer panel structures for Mariner Mars flyby vehicle (AW May 6, p. 58) has begun at Ryan Aerautical Co. Vehicles will have four solar panels with combined area of 78 sq ft attached to base structure. Launch vehicle will be Atlas-Agena D.

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54

time. The extent of operator operation will depend to a high degree upon astronauts' decisions.

During reentry operation, the cabin reentry valve would be opened to permit oxygen to be drawn through heat lamp for purification and waste removal.

Re-entry mode of the ECS involves a number of fundamental changes from orbital operation due to jettison of the adapter sections containing the primary oxygen and heat transport loop components.

In preparation for separation, the module system is turned over to maneuver for a cold-break to reduce equipment and system temperatures to much as possible.

Lines Sealed

After jettison of the adapter, all gas and fluid lines are sealed by quick disconnects and the secondary supply of oxygen is automatically begun. This will then immediately switch to the open-cycle, high-rate flow of oxygen for reentry.

In this mode, the components are turned off and the tank maintains the off valve is closed. The service is designed so that the entire supply of air and/or oxygen will be consumed on reentry.

Allentown expects that the temperature during reentry will sink as low as higher than 55-60°F in the suit and 100°F in the cabin.

Ambient air is drawn into the suit loop, beginning at about 20,000 ft, when the cabin valve is closed, leading to a sealed suit circuit, and outside valve is opened again.

The astronauts turn on the compression valve in the suit loop. Battery power will run compression after reentry.

Pressure Increase

Pressure in the cabin and suit is gradually increased during reentry by action of the cabin relief valve which limits negative cabin pressure to approximately -15.25 psia and cabin pressure to approximately 27,000 ft, when no sole pressure is exerted in the command E1 pass word capsule, the valve remains outside until it enters the pressure vessel.

Manual controls for ECS systems will be centrally located between astronauts so that either one can make the necessary adjustments.

Instruments, located on the center panel, will display temperature and pressure of the cabin and suit loop, carbon dioxide partial pressure, monitor pump flow rate, primary oxygen vessel pressure, quantity of primary oxygen available, and secondary oxygen pressure.

Warning lights will indicate when water storage tank is full and excessive

pressure in the water boiler. With the exception of the water tank status, all the information also will be transferred to the ground.

With these new elements on the ECS system and flight testing scheduled to be limited to one infinite flight with a return capsule, extensive ground tests are scheduled to prove out the design prior to the first manned flight.

Mercer Lessons

Development and reliability testing are both expected to reflect lesson learned during the Mercury program launch, says Gernhardt. Allentown's Gernhardt test manager, and that testing of Gemini components will include simulation environmental tests of vibration, temperature and altitude, and that reliability will be tested by automatic overdrive testing.

Neither of these techniques were used in the Mercury environmental control system test program.

Maneuvering orbiting of the suit and cabin gas loops begins in mid-July at Allentown's Lab in Allentown, and performance tests on the heat exchanger by McDonnell in St. Louis, which has received suit and cabin loop components of the first two systems. ARResearch now is installing a heat exchanger loop in its test system for the next stage of tests.

General overall assessment of ECS system program made by Coffey, NASA's Gemini spokesman manager, reflects in overall Gemini program slippage.

Plan now call the test of the complete system, including the space cabin, to begin fabrication by McDonnell, by 1964.

Re-entry Study Facility Underway at Utah Site

A \$3 billion construction program to support the eventual return of USAF's Manned Orbital Reentry module program, planned while Gemini is underway, is being conducted at the site of the former B-52 base at Edwards Air Force Base, Calif., with completion scheduled for August 1967.

About 500 military and civilian personnel from White Sands Missile Range, USAF and Atlantic Research Corp., contractor for the re-entry program, will be based at the new facility during the two-year operation. The complex will include four firing pads, the blockhouse and a 500-ft, meteorological tower. The site will also include two 77516 testbed rooms and a storage area for housing rocket propellants. Prime contractor for the facility is Olson Construction Co., Salt Lake City, Utah.

Geodesic Construction Engineering Co., El Paso, Tex., was prime contractor for the tower.

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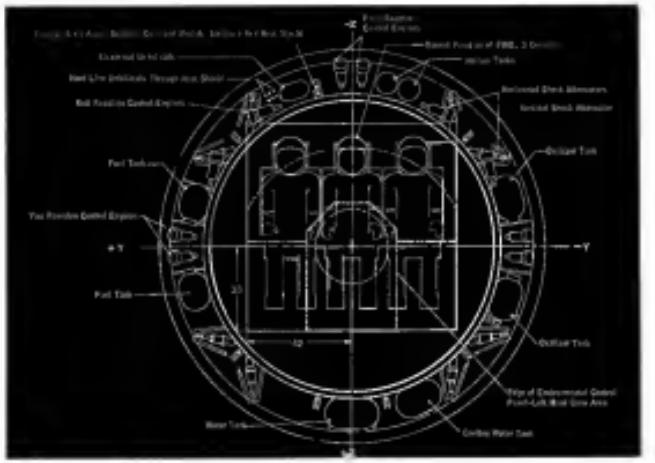
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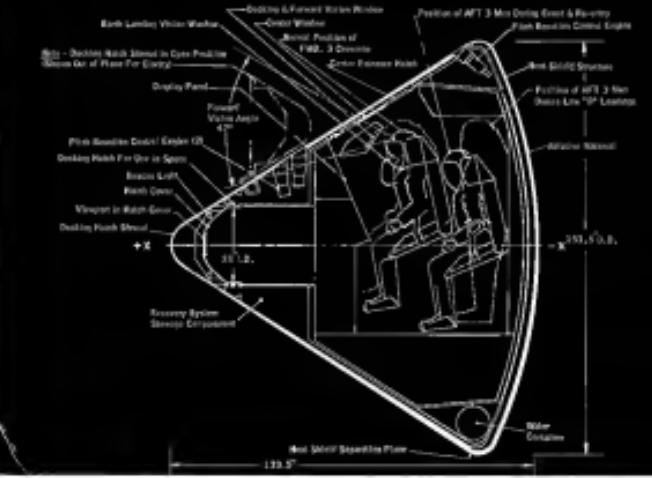
PHANTOM VIEWS of modified Aquila-type Beagle2 spacecraft is shown looking off toward heat shield. Forward thrus crewmen are shown.

Apollo-Type, Six-Man Spacecraft Designed

By Irving Stone

In August, Fullerton design of a two-axis, stabilized Apogee-type logispacecraft (Magpie) is scheduled to be completed at Donnerlair by North American Aviation's Space and Information Systems Div for NASA's Manned Spaceflight Center (AW Aug. 3 p. 23). The configuration is planned to support seven crewmen for a 24-day space station stay in earth orbit.

Top of the new module cannot shell shaft forward atrium position has an exterior hatch featuring a center window. An entire side of that hatch is a window offering forward vision of 47 degrees. The hatch will be closed and locked. Port access around the shaft, punctuated at about shoulder level on each side of the forward atrium position, are earth-landing vision ports.



VENTITUBULAR SECTION of modified Apollo-type apparatus is shown. Six crowsnare are located in groups of three on four and six rows.

to Support 24-Man Orbital Space Station

Each jet has a total arc period of about 200 sec.

This will be on the radioimmunoassay. It will be subjected to the lowest radioactive environment.

Each cluster incorporates four jets, each capable of a thrust of 300 lb for cycling at 15 ips.

Cape module runs proportionately slower than the other two.

It also bears these reactions. Double sets of view jets at opposite ends of the cage results in at least one start per cycle.

ratio of about 10:9:1.

Another pair of catch sites is positioned at the forward abutments' heads, and a patch peg located at top of the saddle, in line with the center abutment position.

Crew module sections control systems ended only during the reentry phase because the module below atmospheric pressure and also to control cell sequencing.

The two sides will be 42F maximum, 21F average and zero minimum. Interior wall dimensions are the same as exterior.

Be - 50F maximum, -67F zero
and -79F minimum.

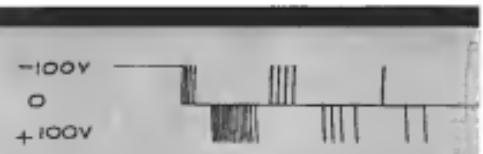
Total storage pressurized concrete will provide an equilibrium temperature of 11°F for extra intensity, 30°F interior wall on the side, and -19°F exterior wall an non-insulated

new module would develop an asymmetric lift with center of gravity along module's longitudinal axis. Offset the center of gravity by locating a counterweight on one side of the module area allows the craft to roll. Trimmed at an angle of -33 degrees from the horizontal, the trimmable weight is located in the forward section.

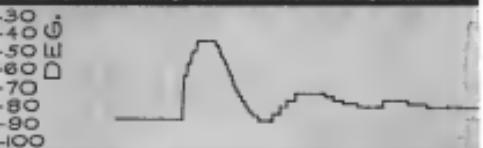
A new module would develop an angle of attack about the centerline which is resolved to yield a lift-force-lift of 0.5. Posture lift is generated at the angle of attack.

anding conditions for the command module will include a capability to land smoothly from a slope less than 15 degrees, and no

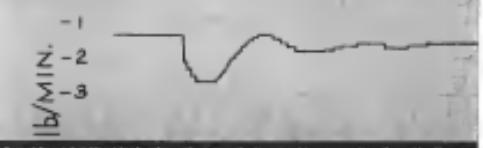
How can a "bargain" temperature control system perform like this?



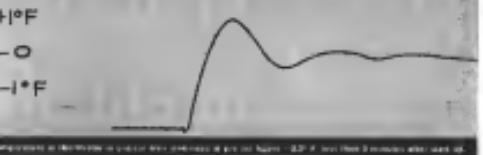
Current Response At valve across high temperature condition in closed area during initial cool down.



Temperature Response At valve across high temperature condition in closed area during initial cool down.



Rate of Change of Temperature Response At valve across high temperature condition in closed area during initial cool down.



Temperature Response At valve across high temperature condition in closed area during initial cool down.

Check it up: to experience, since 1967, United Control has designed and manufactured a variety of reliable aerospace and industrial temperature control systems, proving them in the field, the laboratory, and with ongoing computer studies over a wide range of applications.

Today, nearly every temperature control used today, each fresh requirement can be satisfied quickly and efficiently; after-market service is gaily simple and unanticipated reliability is matched only by outstanding economy.

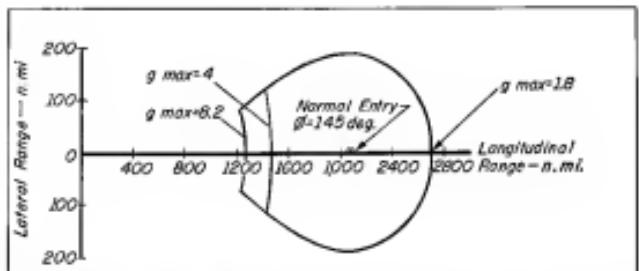


The dependable 1793-1 Temperature Control System, used to regulate gaseous compartment temperatures in the most of American's 10-storey (HEMIS), was put through its paces by the first computer-controlled computer, the compact, lightweight system, consisting of a controller and a Peltier Package, established the pre-set temperature with operating tolerance $\pm 0.5^\circ\text{F}$, in less than 9 minutes (the better the required) — and is capable of maintaining this accuracy for full life. This system also provides many vital auxiliary functions, such as alarm, limit setting, if temperature errors exceed ± 0.45 or $\pm 0.5^\circ\text{F}$, ... stoppage of two-system processes, if temperature varies by over $\pm 3.7^\circ\text{F}$, ... and constant readout for split second determination of gaseous compartment temperature. Both instruments are stored for up to 5 years after delivery, then put in continuous trouble-free service for 3 years — a total life of 8 years.

Studies like this are only part of United Control's unending search for new standards of reliability and performance. Scores of checks, from design evaluation to painstaking repetition of every production component, insure you the highest quality in temperature control systems for aerospace, medical instruments, industrial control areas, food processing, pharmaceuticals, and a host of other unusual aerospace and industrial application. Whatever the solution to your problems entails temperature, environmental, flight or propulsion controls, or aerospace systems and equipment, call United Control, serving American industry—where reliability counts.



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OVERLAKE INDUSTRIAL PARK, REDMOND, WASHINGTON
Phone: 206-895-3711
Parker Scientific Incorporated and United Data Control, Incorporated — Subsidiaries



FOOTPRINT IS DRAWN for modified Apollo-type logistics spacecraft, reentry begins at 400,000 ft. at angle of 2 deg

tumble. The command module will be held to life for one day and provide for a seven day survival period. Equipment limit accelerations will be 50g for all tests, except in the ± 4 deg. range, and no shock greater than 10g will be applied.

The guidance and navigation system (GN) section is a complete control equipment for the modified Apollo spacecraft system. The decision has sought industry participation for this equipment for a low cost effort in the study.

The guidance and navigation system will be self-contained, with no reliance on any earth or space station data link, except for a possible link to the space station just before departure from it. A responder will be available on the space station for rendezvous guidance.

Guidance, Navigation

Guidance and navigation system will contain inertial, optical, radio and other sensors, a guidance computer, pilot displays and control console switches, and backup GN equipment. Pilot participation in GN operation will be limited to those tasks which can be performed without leaving the couch.

The system provides attitude information to the control system, and roll, pitch, yaw, and thrust on/off and thrust commands to the main propulsive engine. The stabilization and control system includes rate gyro, servo loop electronics, jet actuator logic, and pilot control stick. It sends signals to the reaction control system and the main engine gimbal actuator in accordance with altitude, time commands from the GN system or in accordance with pilot control and translational command inputs.

Pitch, roll and yaw error signals will be passed to the GN system during all attitude changes, except during steering and during reentry, when only a roll signal will be provided.

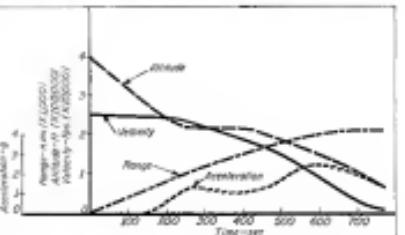


CHART SHOWS orbital entry trajectory parameters for a 2-deg, reentry angle from a 11-deg orbital inclination with the logistics spacecraft.



This hunter is no killer.

U.S.S. Dolphine is the Navy's newest and deepest-diving experimental submarine, now being built by Portsmouth Naval Shipyard.

Dolphine will hunt seafarers.

As she probes deep among the sea's mysteries, she'll also be testing the latest developments in submarine construction and control.

Dolphine's saddles are made of two new plastic materials, reinforced with steel. They're seven feet tall, two feet thick. Tough, buoyant and non-deforming, even under the most extreme operating pressures. We designed and built them, too.

REPUBLIC
ANALYTIC CORPORATION
portsmouth naval shipyard, maine

position combines the Holman upper incisor with the canines.

The mawes are made of the prehistoric and toothless canines erupt.

Reactive-type jets (large model) will be used for orientation of the space craft.

For the last several thousand feet, visual control will be exercised by the crewman, using optical aids.

In the docking mode, orbital relative velocities will be 0 to 2 fpm for angular approach.

Radial alignment of spacecraft will have to be within 12 in. for the location of the X-axis (middle axis of symmetry) with respect to the docking port.

Angular alignment of the spacecraft during this maneuver will have to be within 30 deg.

Spacecraft footprint, depending on payload, will be between approximately 1,200 sq in. on longitudinal range and between 75 and 150 sq in. lateral range either side of the longitudinal range line.

Nuclear Power Studied For Space Stations

Los Angeles—Detailed analysis of nuclear electrical power generating systems for manned orbiting space stations are being performed for National Aeronautics and Space Administration's Lewis Research Center by two industry contractors.

• General Electric's Nuclear Div. is studying reactor heat sources using both direct-cooled and indirect (Rankine or Brayton cycle) power conversion, under a \$612,286 contract.

• Martin Co.'s Nuclear Div. is studying atomic heat sources for their power conversion subsystems, under a \$46,091 contract.

One of the studies (AW July 4 p. 21) is to provide sufficient data to allow design to incorporate nuclear power in space stations early in the design phase of the program.

Space stations envisioned for application of the power system include the following configuration (AW Apr. 4, p. 70):

• Ranging rated Y-type. End-of-launch date for this configuration is considered to be the 1967-68 period. The station will accommodate 12 to 30 men, will have a station life of 1 to 5 years, and will require 12 to 35 kw of power. The station will be 10 ft in diameter and 20 ft deep, and orbital altitude will be 11,000 ft.

• Cylindrical type. End-of-launch date for this configuration is 1967. It will accommodate 7 to 12 men, station life will be 1 to 2 years, and power required will be 2 to 5 kw. Diameter will be 12

PROBLEMATICAL RECREATIONS 184



A one-arm field in the shape of a right triangle has a post at the midpoint of each side. A sheep is tethered to each of the side posts and a goat is tied to the post on the hypotenuse. The ropes are just long enough to let each animal reach the two adjacent vertices. What is the total area the two sheep have to themselves, i.e., the area the goat cannot reach?

We hope you'll all be WEBCON-bound for Frontiers in Electronics at San Francisco's Cow Palace, August 20-23. Marking our 13th anniversary this year will be the numbers 339-3211 and 3312-3317. You'll find us within the limits of the north coast, on the main floor. Try and make it, lad! We'd like to see all our readers there. Non-readers welcome, too.

ANSWER TO LAST WEEK'S PUZZLER: 9 in \times 19 in = 171 sq. in.

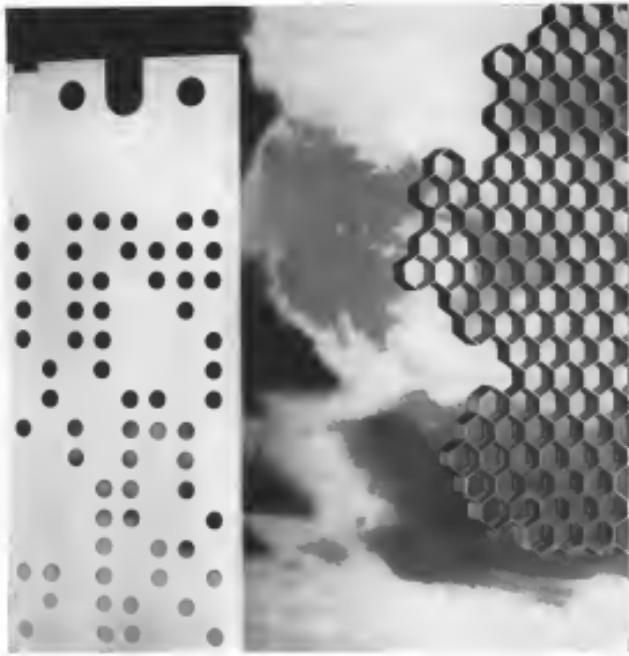
LITTON INDUSTRIES, INC.
Beverly Hills, California

CONNECTOR DESIGN CRITERIA



QUICK DISCONNECT
from massive hercules disconnect tool?

DEUTSCH



Program for a mission, pattern for a launcher

Punched cards and aluminum honeycomb played an important part in the development of an advanced ECM simulator, and prediction of a lightweight launcher for ASROC. While the design problems were different, they were solved by a similar capability—engineering skill and ingenuity offered by Universal Match Corporation's Government Products Group.

A simple punched-card system provides a feasible method for programming the T-4 Electronics Countermeasures Simulator, developed by Reliance Electronics, Inc., a UMC subsidiary. T-4 can deplete virtually any RF condition which a B-52 ECM officer might encounter over enemy territory.

Engineers at UMC's Undyneconomics Division designed flight

weight and high strength needed for ASROC's unique launcher through use of honeycombed aluminum. The unit not only needs eight needles above deck, but also serves as launcher. This innovative design technique points the way toward more reliable launchers of increased mobility.

UMC's Government Products Group offers the capability for solving many diverse problems, and the ability to design and produce advanced systems important to our defense posture.

UNIVERSAL MATCH CORPORATION
Countermeasures Products Group
UNDYNECONOMICS DIVISION

RELIANCE ELECTRONICS, INC.
400 Paul Ave., St. Louis, Missouri
St. Louis, Missouri 63110

it, length 22 ft. Ondset theory will be 150 to 180 cu.

The studies are not limited to systems available in the 1975-95 period, but include more advanced concepts.

The studies are divided into two phases. Phase I is a feasibility analysis which defines space station power and environmental requirements; assesses the nuclear hazard associated with reentry of the orbiter and payload; requires and recommends all information needed to conduct normal operations; develops smooth reentry and escape. Comparative position of nuclear electrical power with respect to other power systems (fuel cells, solar cells, and solar dynamic) and solar thermal; reentry will be analyzed. Phase II will be completed early in November.

After review of Phase I results by NASA, Phase II will be initiated. The first test under Phase II will be to provide ground power to the orbiter during simulation of orbital dynamics; certain aspects, a comparison of acoustic and nuclear heat sources and reentry heat shield weight, cost, and powerplant configuration.

The second task under Phase II will be a conceptual design of a nuclear reactor power system for the orbiter with soft landing, reentry, thermal protection, docking, repair, refueling and escape.

Other factors to be studied include radiator design, structural integration and control, start up, shutdown, and reentry methods. Life of the powerplant will be considered with respect to power level and number of start/stop cycles. Integration of life support, vehicle stabilization, and nuclear power systems will be examined.

The third task under Phase II will be to define the optimum nuclear electric powerplants for planned space stations, namely the potential life spans of the SNAP power sources now under development, and modifications and development required to adapt the SNAP source for space station applications.

Life Support Study

Study of the chemical and nutritional qualities of dehydrated plant food after being conditioned over the next two years, using rats as subjects, is part of USAR's School of Aerospace Medicine's work on development of a life support system for astronauts.

The study, to be handled by Roman Houser Laboratories of Chicago, will determine whether the diet will be able to support growth and what would make these products nutritionally complete.



This life support system took two hours to get the male answer.

This interviewee will sleep five weeks at Bios Internationale within a total elapsed time of 120 to 150 days.

It will perform reliably under temperatures from minus 55°C to plus 80°C, with a voltage range from 20 to 55 volts. It uses 11W x 37W.

The drive selected was a Lenox Star 01 rotary servo. This gave the speed and power required to make the swing motions on a single disk rotary control.

Positive control of the speed was provided by the utilization of a counter/timer.

To carry up such a design, we needed an engineer with a broad field of science experience and one with a broad field of modeling experience. We have both at place.

We often team together here at Lenox on jobs like this, because people are seldom one, man and moon, to design and produce a package that will provide a complete remote control job. We're generally at one best on jobs that require switch ing, actuating or positioning, along with tight space requirements.

If you have a tough one, send it along, or please us at 113-224-5601. Or write for our "Mass Work In Less Space" booklet. It tells what we can do. Lenox Inc., Dayton, Ohio.

Do it today.

Cliff Glase
Product Engineer-Astronaut



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Lunar landing gear . . . from the people at Bendix

Landing struts for lunar excursion craft and landing skids for manned re-entry vehicles. □ Other people at Bendix are working on engine control systems, landing gear, rocket equipment, high temperature composite materials and nuclear mechanisms. An Aerospace team of skilled and experienced people . . . skilled in all phases of program management, backed up by complete engineering and production facilities, give Bendix the capabilities to undertake many varied Aerospace programs. □ To find out what this Bendix team can do for you, write: General Sales Manager, South Bend 20, Indiana.

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- Rocket igniter circuits
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ADVANTAGES

- Complete flexibility — open or closed
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- Simple, rugged construction

This highly reliable microswitch-style single-pole acceleration switch activates critical equipment without the need of electronic circuitry, in response to desired accelerations. Its gas-damped spring mass system is design-engineered for efficient operation in projected field use, and assures peak performances under severe vibration shock conditions. Mounting and applicable MIL specifications, it is air-dependent for monitoring, limiting, or analyzing "g's" in a variety of aerospace applications. (A bi-directional switch is also available.)

Full technical information on these versatile devices is available on request.

WRITE TODAY FOR COMPLETE LITERATURE AND SPECIFICATIONS

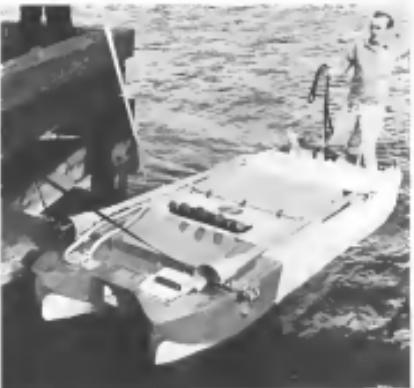
MAXSON ELECTRONICS CORPORATION

SUNRISE HIGHWAY • GREAT RIVER, LONG ISLAND, NEW YORK



USAF Tests Water Retrieval System

Cook Electric Co. Inc. developed water retrieval system for USAF which is capable to recover up to 1000 gallons of water from depths of 100 feet. USAF is testing system at Lake Michigan. Heart of recovery device is a small unmanned boat (boat) powered by electric motor. Boat is lowered from aircraft and lowered into water by parachute. Aircraft crew research guides boat to target (jet) during above the sequence of operations. Boat can also home in on target if fitted certain sensors. When boat reaches proper range, it fires out line over target with two-holed drogue gun. Boat then maneuvers close to target, pulling and cutting target jetline from line. Finally, boat is arrested on deck, and pickup truck is used to haul boat. Aircraft lowers recovery device, unhooked and roll recovery target. Second boat is selected for recovery of boat or target.



New Radar Telescope to Map Ionosphere

By Philip J. Klass

Arecibo, Puerto Rico—An unusual radio telescope, 40,000 times more powerful than the Millstone Hill dish which first made contact with the planet Venus will become operational within seven weeks here in the Arecibo Observatory, Chico, P.R.

The new facility, believed to be the world's largest and most powerful mapping radar, was built under the sponsorship of the Advanced Research Projects Agency at a cost of about \$3.2 million. It will enable scientists to find ways to map a detailed profile of the various layers of the ionosphere, the shell of ionized particles surrounding the earth which plays an important role in terrestrial radio communications, in ICBM detection and tracking, and which potentially affects our weather.

Natural Belt

The 1,000-ft-dia antenna itself is a natural mountain bowl it was formed by a 2% megarad, pol-polymer breccia appearing at old age. The antenna is expected to have a gain of 60 dB and generate a beam whose width at half its dep. (Photographs do not adequately convey the gigantic size of the new observatory or of the construction facilities involved.)

Previous radar telescopes, both here and in the Soviet Union, have only been able to make contact with Venus, Mercury and Mars when the planets were in close proximity to the earth. They

also had to rely heavily upon data processing to extract the weak radio echo from the background noise. The Arecibo facility should be able to track out to these planets at any time that they are within the field of view of the radio telescope, and receive signals generated by the Venusian, Marsian, and meteoroids of the observations.

Radar contact with even more distant planets, such as Jupiter and Saturn, also may be possible when they are in proximity to the earth.

While the Arecibo facility will greatly extend the reach of radar instruments, its primary objective is to make a detailed study of the ionosphere. Due to the nature of the space age, scientists were unusually handicapped in efforts to make a detailed reference system for which ranges from a few feet to 100 mi to about 250 km.

The availability of satellites and rocket probes has provided partly increased knowledge of the ionosphere, but because such probes and satellites can explore only a limited sector of the ionosphere at any time, and because the composition of the layers changes with time of day, season and solar conditions, it is difficult to obtain a fine-grained profile and sort out exact effects. This is the void which the new observatory needs to fill.

The Arecibo Ionospheric Observatory is the brain child of Professor Wilfrid G. Glodius at Cornell University who was appointed director of the facility. He suggested that the山地的山脚

utilizing from free electrons in the ionosphere at ultrahigh frequencies (UHF) was sufficient to provide a detectable signal. Measurement of the magnitude, spectrum broadening, and coherence of these parameters could be used to determine the presence of free electrons and electrons in the ionosphere and to study the effect of solar flares and so-called "geomagnetic waves."

The coherent backscatter is so small that for conventional low-power radars, the ionosphere is considered to be transparent above frequencies of about 300 mc.

Important Role

Glodius proposed using a high-power transmitter and an extremely large receiving antenna. Because the propagation of the ionosphere is far from a perfect媒 for UHF detection and down discrimination, the Advanced Research Projects Agency in 1958 agreed to fund the concept as part of its Project Defender program. For exploring new ICBM defense techniques, Cornell University and the Army Corps of Engineers were invited as power contractors with the Air Force Cambridge Research Laboratories assigned to provide technical management. Contractual funds were \$1.5 million.

Engineering the technical difficulties and costs of building a massive horizontal radio antenna of rock-hewn dimensions, Glodius proposed that if one station were built as a normal bowl with an overhead feed which would prevent

the losses to be incurred over an angle of 6 deg over side of vertical, 8% locating the facility near the equator, rotation of the earth would provide 360-deg azimuth coverage in the ecliptic plane, and a 1/2% of the earth's surface.

All contractors from Laboratories involved upon this site by suggesting a technique that would permit the beam to be scanned through an angle of 30 deg from the zenith. This important improvement was made possible by a research study which had been conducted almost a decade earlier by three AFGL scientists, Drs. A. G. Spanswick, C. J. Shattock and J. E. Walsh. They had developed a relatively simple technique which consisted of a spherical reflector with a phased array feed source employed to prevent obscuration. (For a description of the technique, see March 1943).

The Arecibo Ionosphere Observatory is located roughly 12 mi south of the Puerto Rican city along the northern coast where it cuts the base. The site was selected after an extensive survey of areas located near the equator whose topography provided natural berms. The Observatory is situated at approximately 18° N. latitude and 66° W. longitude, enabling it to scan the entire plane. The soil climate here, with a temperature variation of less than 30 deg during the year, is favorable to dimensional stability of the large antenna. The enormous hills offer some protection against high winds and some electromagnetic interference.

Spherical Form

During use of a normal bowl, antennas had to dry out blot and nearly 300,000 cu ft of air must be blown into the bowl to dry it before it can be used. Because the radio beam can be viewed only 20 deg dia. side of the zenith and about 40% of a hemisphere had to be illuminated for the dish, the radius of disk coverage is 875 ft while the distance across its upper lip measures 1,000 ft. Total dish surface is 1,000,000 sq ft.

The 90-ft-long spherical area feed has a support over the dish by means of a triangular-shaped platform, supported by four sets of main cables suspended from three conical concrete towers spaced at 120-degree intervals around the dish. Each set of main cables consists of four 3-in. dia. cables. To provide rigidity to the system, the triangular platform is anchored in a mass of 15 in. dia. reinforced cables. Two of the towers are 40 ft high; the third is 35 ft.

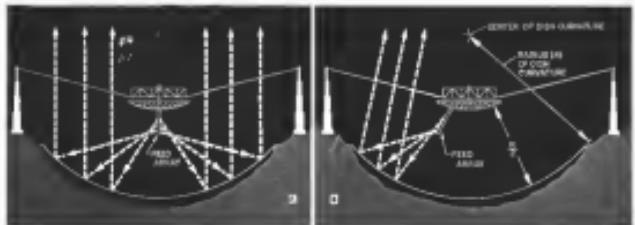
A 54-ft-tall, conical-shaped tower, called the feed arm, is supported from the triangular platform by means of a circular track, with electric motor used to rotate the arm in azimuth. The



SUSPENDED FEED In satellite observatories, feeds in construction (above), shown 340 ft long, resemble birds' nests which range in length from 100 ft and two parabolic lenses which will receive signals from fixed radio sources in the sky. Two storage berms rising in stages toward center of dish opposite each end of dish to keep three bays balanced. Note top of stationed concrete supports holding dish from which the platform is suspended; lower right of photo. Support is by means of three sets of main cables, each consisting of four cables of 3-in. dia., at rear, right center, points to worker to illustrate great size of the facility.



NEW RADAR TELESCOPE, left, in the middle height, was planned to receive radio 40,000 times stronger echoes than Millstone Hill's dish is reported to have received near Puerto Rico, seen. Site of the facility can be gained from group of workers (arrow, left center) shown 700 ft long walkout to overhead feed mechanism. The 300-ft feed antenna is suspended by cable from three teams of reinforced concrete, one of which can be seen in the background.



ARECIBO RADAR'S ABILITY to scan 20 deg off the vertical with fixed dish results from use of technique developed by Air Force Cambridge Research Laboratories more than a decade ago. Arecibo uses spherical dish and 90-ft-long phased-array feed instead of conventional paraboloid reflector and point source. By using linear dimension of square-wavelength feed line to control range amplitude radiation at each point along its length, and the length of subtending this in radial plane of range, the spherical dish shows no in-phase equal-amplitude wave front was found as shown in (A) above. To cover beam to same vertical angle, coverage losses increase about a constant which keeps top of feed over steep at a distance of overshoot dish's radius of curvature from the dish, as shown in (B).



7 seconds . . . done!



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GIANT BRIDGE, covering 350 acres, is made from pounds of steel mesh which are supported by thousands of cables that connect to overhead and overhead structures. Tension cables and ballast rods are adjusted to give desired spherical curvature to deck.

midsection of the area is located 415 ft above the bottom of the dale, corresponding to half the deck's radius.

Along the curved midlands of the area are two trunks running lengthwise from which are suspended two small "tongue houses," one either side of the center. The phased load line is suspended from one of the two tongue houses, while the other passes over another habitat but later will be equipped with a vertical load line designed to operate at different frequencies.

To ease the subsidence basin work required to support the bridge, the 50-ft-deep load line moves out from the main (center) position, while the other carriage houses move in toward the opposite direction to balance the structure. Thus the two carriage houses move in unison, either toward or away from the center of the meadow-shaped area. To ease the bearing on unstrut, the entire crescent-shaped area rotates with respect to its supporting triangular plot.

The entire structure, weighing about 180 tons, is designed to be so rigid that the end of the 96-ft load line will not shift position by more than an inch in the presence of a 10-ft wind gust, according to Philip Blacksmith, AFCRL project officer.

Work already is under way to build a transonic air-tunnel to permit measurements to be made at 40-cm model speeds with flow at 400 m/s, to determine the effects of frequency. Preliminary design has been completed for a transonic wind tunnel to operate at frequencies up to 4,420 cps, corresponding to the highest low vibration frequency, and that the influence of the deck and its load will persist well beyond.

The dish itself is fabricated from

AIRPORT WEEK & SPACE TECHNOLOGY, August 19, 1983

LIO
LINEAR ACTUATOR



300 lb.

**Maximum operating force
in a miniaturized package**

Miniatured, but with a kilogram power capability, the new LIO actuator is ideal for applications where size is the primary determinant. The LIO provides a 3-in. working stroke adjustment over its active range in a retracted length of only 414 in.—a high ratio made possible by unique internal structure. The LIO's construction utilizes a piece molding route—one-piece environmental gear case. The LIO is available with a ergonomic handle which permits easy use to virtually any point of the actuator's stroke and permits use of high efficiency gear drives. Large range of speed and power options is available. The LIO actuators total weight is only 8 lbs. Dimensions to MIL-A-8084A and is equipped with a noise/vibration filter that complies with MIL-S-883C.

Write for new Product Bulletin PD-02

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Beech-built "missing link" ends make-believe training

KD2B-1, now being produced under U. S. Navy contract, is another example of Beech's systems management capability

The Beech KD2B-1—shown above—is America's first missile target system to match the performance of the fastest enemy jets. It ends the need for target towing, flying, or simulation of any sort. By matching actual supersonic aircraft speeds, altitudes and turn characteristics, it provides realistic, realistic training. It can evaluate proficiency of every advanced weapon system, including radar-directed and heat-seeking missiles.

But weapons evaluation is only one of the many jobs the Beech KD2B-1 is capable of doing. It has capabilities for use as an inexpensive operational

module. Its payload capacity and low-maintenance design fit it admirably for a wide range of tactical missions.

The KD2B-1 is easily adaptable to air-launching, surface-launching, or ground launching with existing equipment. It is capable of Mach 2 speeds at 70,000 feet and Mach 3 speeds at 100,000 feet.

Designing, developing and building satellite systems is one of the many elements that make up the comprehensive Beech capability. It's one reason Beech is prepared to undertake complete systems management responsibilities for a wide range of space-age projects.



Other Beech Capabilities In Systems Management Include:



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How may we help you? To discuss how the proven capabilities of the Beech organization can be quickly and efficiently put to work on your project, write, wire or phone Contract Administrator, Aerospace Division, Beech Aircraft Corporation, Wichita 1, Kansas. Beech stands ready and eager to accept complete systems management responsibility for your project right now.

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BIGGEST SPACE CHAMBERS BUILT... BY PDM

PDM has designed and built two space environment simulation chambers for NASA's Goddard Space Flight Center at Greenbelt, Md.—the largest high vacuum chambers built and tested to date. Each a 33'6" x 58' high, has a fully removable head, a stainless steel shell and a #4 polished interior surface. One is shown here.

These almost-identical twins were designed for ultimate 1×10^{-9} mm Hg operation. One is equipped for ultra-high vacuum and has been shutdown-tested below 1.4×10^{-6} mm Hg—a full decade better than specified. The other is planned for dynamic testing at lesser vacuums—but is suitable for future upgrading.

In the meantime, these "almost" twins provide flexibility, performance and full-scale checkout capability for the largest space vehicle systems.

Consult PDM on your space facility requirements. Twenty-five years of experience in the design and construction of aerospace facilities are your assurance of performance. For information, phone, write or wire Pittsburgh-Des Moines Steel Company, Neville Island, Pittsburgh 25, Pennsylvania. PLANTS AND OFFICES IN 20 STATES



PITTSBURGH-DES MOINES STEEL COMPANY



SLOTTED WAVEGUIDE running along underside of central diagonal arm, with lines to keep net loads and storage capacitors, transfers radio energy to storage house and its feed line.

clear the debris without damaging the tanks; clean-up operation will run water-in, according to Peter Wilden, business manager for the observatory.

The 2.5-magnitude telescope, built by Radiation at Stanford, is housed in the 3.45-ft-dia. It operates by shifting of the observatory. Telescope energy is piped by waveguide to the base of tower T-12, situated due east of the major tower. The base is in the elevated pedestal floor, where high-level cables lead out to the suspended platform, for a total distance of work-use level of a mile.

A huge rotary joint, which permits 360 deg of azimuth rotation, handles the massive range to the external-mounted feed arm. The latter contains a 160-ft-long slotted waveguide which permits energy to be transferred to the storage house and powerlines, and back to the change elevation position.

The storage house is outlined on three complete levels of "brick-cells" to provide storage of both horizontally and vertically polarized signals over 1000 hours. Each includes a low noise Zeuthen electron beam type microwave amplifier, low-loss RF amplifier, crystal mixer and intermediate frequency preamplifier for converting the received signal to 100 mW for transmission via the antenna in the observation building. Design objective is to achieve an overall system figure of 2500:1.

In Philadelphia, the antennas were

designed and built by scientists at Com-

plex. The radio transmitters, using Eimac klystron tubes, can be operated either as a pulsed radio with peak power of 2.7 megawatts or as a continuous wave radio with 150 kw average power output. Transmitter is designed to generate pairs of pulse waveforms with repetition rates of 1-10,000 per second and pulse duration of four microseconds to 10 microseconds, according to Dr. Peterberg. Both the transmitter and receiver have been installed and under

test here for more than a year, using a small feed horn + feed mode for during this period.

The operations building facility is stages a Control Data Corp. 160-kilobyte computer which will be used in a polarization data processor for generation of observer data. A digital data-link system, supplied by Melpar Electronics, Inc., will be used to receive encoded messages of photons to locate the required reference naming point.

The Arequipa Observatory will be manned by a staff of approximately 15 professional scientists and engineers plus an additional contingent of 25-35 persons for support and maintenance. Approximately one-third of the professional staff and half of the support group are natives of Puerto Rico. Additionally, students from the University of Puerto Rico at San Juan are expected to find summer employment.

Puerto Rican officials have been extremely cooperative in accommodating the needs of the new facility, according to Blodgett. The Puerto Rican Water Resources Authority built a special electric substation and an booster pump underground to overcome the possibility of cable interference. The government granted a regulation which limits the use of radios to eliminate in the vicinity of the observatory. While this has not been a problem to date because the area is largely agricultural, it is a welfare problem.

The \$5.3 million spent to build the new observatory, including a mile of roads laid, is several million more than the city estimate. Despite the magnitude of the construction and lack of experience in building comparable facilities, Blodgett won a bid during prequalification, resulting in fixed-price contracts rather than cost-plus-plus fee, except for the \$6.1 long-lead-line feed horns by Technical Research Group (TRG).



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ABILITY OF MICROCIRCUITS to survive intense radiation without serious damage at their extremes is being investigated by Hughes Aircraft Co. with a tracking wire locus electron accelerator shown here. At left, unirradiated microcircuits appear more reliable in intense radiation, of the type produced by a nuclear weapons test, than other microcircuit types.

Microcircuit Radiation Problems Probed

By Barry Miller

FELTON, Calif.—Semiconductor microcircuits appear to be more vulnerable to the intense neutron radiation that accompanies nuclear weapon bursts than are other forms of microcircuits and circuits constructed with the best high-frequency techniques.

The insensitivity of semiconductor microcircuits to disturbances caused by high gamma-ray rates generated in a nuclear explosion can be realized, however, by exploring circuit logic techniques that minimize the use of transistors.

This is one of the preliminary conclusions of investigations of nuclear-circuit performance in public, in fissile, nuclear radiation environments being

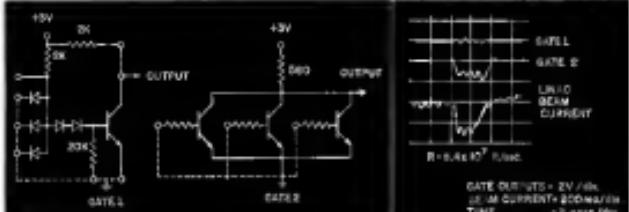
conducted by the Nuclear Test Division of Hughes Aircraft Co. here. Although semiconductor microcircuits previously were reported of being vulnerable to this type of environment, the Hughes tests, based on linear electron accelerators and neutron exposure, are thought to clear evidence of it.

The tests are being run by the division's Test Division Radiations Effects on Devices (TDR) project section under heading of a larger Navy Bureau of Weapons contract aimed at exploring radiation effects on atomic weapons.

This is the name of a government-wide capsule panel sponsored by the Defense Atomic Support Agency, which borrows resources of several defense agencies and universities to

DATA how an atomic device should be spent in this era. The TDR panel has fine enough to foster an awareness of the hazards of transient nuclear radiation (AW Aug. 19, 1960, p. 58) during the second year of its existence. Other preliminary results of the Hughes tests indicate:

- Experimental thin film insulated gate field-effect transistors (IGFETs) p-n-n are unaffected by intense radiation rates of 10¹² Röntgen/second over a dosage spectrum of between 4 and 6 Mrad, at least one order of magnitude higher than the rate at which significant transient radiation effects occur in some standard bipolar microcircuits. Peak rates of 10¹² Röntgen/second to 10¹³ Röntgen/second start to produce distorted signals in certain conventional circuits in the



TWO MICROCIRCUIT GATES investigated together in a high gamma-ray rate environment, typical of what would be expected from a nuclear weapon burst. Gate 1 (left), made by Fairchild process, is believed to be less sensitive to radiation, as evidenced by greater insensitivity of output voltage, as shown in successive instrument tracings (right). Magnitude of Gate 2 response might come from triggering of other circuits.

neighborhood of a detonation. A rate of 37 Rutherford/sec. is now usually regarded as the threshold of acceptability for most aerospace.

- PIN junction field effect transistors in transient inhibition environments can fail no better than the host. High frequency bipolar transistors are available that appear to be destroyed at levels of about 10¹² Rutherford/sec.
- The 500 millisecond expansion release concept, in short one order of magnitude no transient failure reduction from the comparable hold times, dictates passive components of the logic must be reliable today by a number of

semiconductor manufacturers for bonding requirements.

These results could have a bearing on the selection or use of semiconductors for systems which must survive in a transient nuclear environment. For other reasons their potential reliability, promise of maintenance-free operation, low weight and low power consumption, light weight and low power consumption, low cost, and long lifetime make the new weapons systems, and in particular equipment for aircraft. But the process of building systems which must survive in the transient environment might preclude the use of certain types of semiconductors or dictate design

In Hughe's experiments, small quantities of monocrystalline manganese, removable from two substrates were compared in various transient environments. The two materials had roughly the same logic capability. Significant transient radiation effects occurred in one material at 10¹² Rutherford/sec. at one-quarter the level, while the same effects did not appear in the other. In Sigratex data, until the radiation level increased by an order of magnitude.

The difference, according to Robert W. Marshall, manager of the industrial staff here, can partly be attributed to the use in the Sigratex device of a higher frequency transistor. Generally, higher frequency transistors are less susceptible to transient failures. The reason for this is that high frequency transistors have carriers that appear and disappear more rapidly than do lower frequency transistors due to transient radiation damage deposited in the several drifts of the transistor's base.

Significant Hypothesis

Of more significance, however, is the hypothesis, explained by Marshall, that the need to isolate transistor device regions within the semiconductor substrate tends to create large and back-to-back PIN junctions. The lack of the dielectric breakdown voltage of groups of transistors are affected, as in N-type material in a P-type base. The collector regions of the two transistors are separated by a P-region which effectively becomes a diode made for a pair of large diodes formed with the two collector regions. Transient radiation tends to create leakage paths through the diodes to ground, effectively grounding the collector. This is a problem that the devices which are deposited on insulating substrates do not have.

Of the two types of semiconductor structures used in the Sigratex gate, as indicated in an accompanying diagram on p. 33, has only a single

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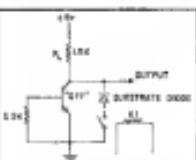
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TEST CIRCUIT used to determine the effect of substrate diodes connected to ground (bottom) lead of feedback micrologic transistor. When diode is inserted there is an appreciable increase in collector leakage current, responsible to what can be expected in a semiconductor transistor.



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Transient Radiation Effects on Avionics Systems

Nuclear explosions can induce severe disturbances on electronic systems which are outside the destructive range of the weapon's host and boost effects. While the disturbances predominantly transient in nature—may be very short in duration, they can have a serious effect upon a weapon system.

For example, a pulse of induction caused by a nuclear detonation might prematurely trigger a diode circuit or damage a memory circuit in a gallium arsenide, causing a guided weapon to be off-set of course.

Thus, although the total dose of radiation from the nuclear pulse might be negligible at a given distance, one could not ignore the potential damage the equipment, a circuit or a subsystem that would propagate errors of a mission. (For a detailed discussion of this subject, see AW Aug 5, 1975, p. 16.)

The term "transient" as used in transient radiation effects refers to the reference environment, not the effects. The environment is caused by a burst of pulses of induction and hence is transient. The effects on avionic equipment or components may be either transient or steady state phenomena.

Heat and evaporation from the nuclear burst or the shell mass of potential damage to avionic equipment. The equipment to accomplish sufficient radiation doses to be disabled or destroyed will depend on what it is within the environment, such as the type and level of heat.

In time, the transient effect problem becomes more acute. There, the damaging effect of successive pulses (the principal cause of transient breakdown) is extended to the absence of the atmosphere, which otherwise would shield these pulses.

Transient breakdown on the result of electron processes, or ionization, which produces various current loads. An intense, sharp rise of current may reflect in the heat in the primary cause of the electron processes. A notable, low-intensity pulse of induction produces a minor amount of ionization, but is responsible for a large amount of atomic displacement causing permanent damage to avionic devices. Electron breakdown requires steady state energy within the device, which appears to be incompatible for transient breakdown, without more permanent effects. Some permanent, or steady state, damage occurs with time.

The transient breakdown then is usually time dependent, caused by the intense high current rate of these currents. Phenomena which depend on the time under the pulse, or the integrated dose, do effect.

Typical transient components subjected to pulse radiation may react as follows:

- **TRANSISTOR**-are severely affected by ionizing radiation with a sharp increase in current. Transistor breakdown occurs at a current produced in the base region of a transistor, the current appears in the collector multiplied by the beta of the transistor. The current can be

transistor, while the other has three. Then, the SiGe/Si gate has a smaller diode area, accounting for its superior performance in this transient radiation test.

Marshall Space Concerns that the present lead in semiconductor manufacture today is toward more transistors in a circuit, which, if the Hughes thinking is correct, would make them less reliable for the nuclear burst environment.

In the comparative test of the two

diodes to form a transistor on, Transient pulse rates between 10⁷ and 10⁹ Rutherford/s will start to produce effects in a good quality, high speed transistor in a few microseconds. Permanent damage to a high frequency transistor may occur at 10⁷ Rutherford/s, a few orders of magnitude lower than this for low frequency transistors with long bias times.

- **Resistor**-resistor will be absorbed by linkage effects and by gamma pulses. A normal resistor in a high gamma rate environment can be represented by a resistor circuit with a resistor of the original value divided by a second resistor, the value of which is increased proportionally to the gamma rate. As the value of the second resistor increases, the value of the resistor decreases, resulting in a decreasing resistor leakage. A secondary effect which may appear starting at about 10⁷ Rutherford/s, caused by gamma interaction with electrons, effectively adds a current generator of a value proportional to the gamma rate at series with the resistor.

- **CAPACITOR-Capacitors are affected as severe were, perhaps the most significant of which is an increase in the conductivity of the dielectric material under influence of gamma rays.**

- **Magnetic Devices-Magnetic devices do not represent transient or permanent effects, since other factors are so dominant, but electromagnetic fields created by a nuclear burst do affect magnetic components.**

Experimentally regarding the measurement of a nuclear blast, including the proper pulse length and shape, peak rates and spectra of energies for protons and the current gamma and neutron rate dependence, is extremely costly and difficult. The Sandia Pulse Radiator Facility (Goddard) is used increasingly probably because it is the only device that can provide the high neutron rates (27 x 10¹² neutrons/cm²/sec). Tel Godiva is a pure simulation of the urban nuclear burst environment except for the neutron and thus only for a particular range. Gamma ray simulation is carried on either facilities such as a linear electron accelerator, or Hughes Aircraft has done (see p. 95).

Typical techniques is to test at different facilities, at specific energy and frequency matched and suitable source to actual field conditions.

The transient nuclear environment is also one that is approached with care. This is determined by the various test methods, through weapon burst evaluations. Having a return to previous test environments can add millions of dollars to the cost of a weapon system.

Making no component failures prove need not under prolonged radiation survival components. Transient noise reduction of gross currents can be reduced by selecting higher frequency insulation, using higher density bus conductors, plus employing greater quantity, larger bus sections, and more robust low resistance connectors to improve insulation lifetime. For some environments, perhaps power tubes above 10⁷ Rutherford, substitutes for conventional devices may be necessary.

subjected to transient radiation. Both current noise tests and no load noise have a high impedance current follower.

Hughes is continuing its examination of this circuit, comparing it as a round robin basis with other semiconductor manufacturers. The film resistors and discrete component circuits, of roughly the same overall configuration. A thin film hybrid construction gives the power elements, discrete transistors, made by Philips, has per-

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pared better in the environment than the semiconductor memory tested for, including The Signet gate. The Philco thin-film hybrid showed less voltage change, by about 25% of the test rate, than did the Signet gate. The radiation tolerance of hybrid thin-film circuits is limited by the transient load in the circuit, according to Marshall.

In another interesting test series, Hargens examined two identical metals, one composed of thin fine needles and the other of coarse irregular particles. Both were a bimetallic system consisting of 50% tin and 50% antimony; the former containing the larger type of transition metal half-spherical inclusion. When the solution temperature which can be compared between the collector and the cathode (ground) was the hexagonal form so that configuration in both respects the performance of the two different solutions was comparable. When the electrode on the transition system was immersed, the performance of the two was markedly different as can be seen from Figure 1. This tends to strengthen the popular belief about the role of large inclusions in degrading material performance.

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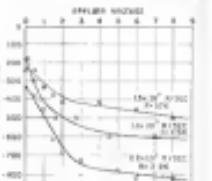
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The effect of the solution diode can be demonstrated qualitatively. A test of a standard bolometer planar matching transistor is shown off-hand in Fig. 1 p. 89. Supply voltage is applied through collector load resistor R_C to the collector-emitter diode. The base is grounded through a 2,100-ohm resistor so that the transistor is in the "off" condition. The output of the solution diode, shown in dotted lines, is connected to ground [bottom] as indicated in ref. 1.

The transfer is unidirectional, but the two regions are isolated from each other.



HL-LINEAR RESPONSE of ball sources
for rotation (of the type employed in
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to infrared radiation of known intensities
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Microcircuits Survive Van Allen Belt

Semiconductive materials produced by three different manufacturers have demonstrated sufficient resistance to neutron radiation to indicate they could operate at least one hundred years without failure. The data from Allis-Chalmers and the two suppliers were the limiting factor in their lives, according to Minneapolis Electric Transmission Co., in St. Paul, Minn.

Hewes et al. measured this from tests on monolithic shock at conducted with University of Florida. Testing location at Gainesville, Fla. The consumer's interest was present in the shock test after publication of Hopkins' paper [4]. A few different in the earliest weapons load environments explored by Hopkins (see p. 95). It is directly concerned with the ability of digital computers using microcomputer microprocessors to survive the dose effects experienced by orbital vehicles traveling in the space environment. The first test was conducted at the U.S. Air Force Research Institute in Wright-Patterson Air Force Base, Ohio, in 1978. This was an attempt to determine the performance effects of integrated circuits from stretching as high as 50% undamaged/ μ m², called "tensile high-gamma rays which cause transients and

Carrying out effects were incrementally unpeeled until

Honeywell recently is producing a computer memory for the Air Force's 18 (Dove Star) program, which uses Fairchild semiconductor components. Computer engineers tested four groups of memory-based units connected. Martin 100T gate array, Fairchild 17G gates or logic, two Texas Instruments 29651A or seven, two discrete component NAND gate and four 2N705 transistors to implement the memory bus arbitration.

The insects were tested in the University of Florida 1946, white-tailed colubrines which is capable of producing flat rates of 3 to 80° centigrades/hour. The insects were exposed in steps to gradually increasing flat rates so that mortality could be maintained at different rates to be sure rate of reduction, when a critical dose, was producing any damaging effects.

The elements were exposed as an integrated design at 10° orientation—according to the dose they would receive is a continuous slot within the Van Allen belt roughly 180° from the start. Total dose per year would be 2.2×10^8 neutrons/cm², about 3.6×10^8 neutrons/cm² for one hour of exposure to a solar flare using MRI.

2.3×10^4 *insectivores*), an enlarged due which would be responsible for about 10 years' toothwear exposure in the Yax Altas Isthmus. I think all my original lenses from the Texas Isthmusian environment have disappeared. At the end of the tests, the *Festucolella* class showed some deterioration in wear shape, reflected increased pyramidality in the subject wear surfaces. Neither the *Sphaerites* class nor the *Leptostomella* class exhibited any significant wear increase, probably because it employed higher speed turntables and the resulting linear impacts destroyed any deterioration. I shall design engineers' 'Story Testers' so as to prevent such problems in the future; this is one of the realizations arrived at through close liaison with the manufacturers of industrial equipment in the meantime.

they approach or not introduce additional disturbances. The peak dose rate was 17 v 10 Roentgens/sec. With the 17 v 10 Roentgen dose, about one-half

Field effect transistors have been developed by Westinghouse to be more resistant to power-line induced damage. These devices have been designed so that they can withstand up to 1000 VAC. They have no better than the best high frequency transistors available on the market.

Subsequently, we measured ionization levels and found it to have a threshold of 10 μ Rads/second, while this same dose rate released from Melpar, equivalent to 10 μ Rads/second, showed negligible activity.

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Condit Corp. Motor Study Annuls—Contracts totaling about \$150,000 have been awarded by Communication Systems Corp. to three companies to conduct two-month studies of different techniques for passing multiple ground stations with minimum interference between satellite transmitters (IAW July 22, p. 339). Awards went to American Telephone & Telegraph Co., Hughes Aircraft and Rockwell Corp. of America. AT&T will extract various modes which are based on each ground station, regulating its power output, while RCA will investigate use of a receiver "hopper" within the satellite. Hughes will study multiple-satellite problems for a microwave-type multiple including use of a moving wave for the transmission of 200 separate channels. The RCA and AT&T approaches are applicable to medium or synchronous satellite systems.

Far-Pelt Thermostatic Cells Disapparing—Results of tests of small thermostatic pouch built by General Atomics and flown on two Air Force satellites were "considerably below expectations," G. W. Glassman, USAF's Atmospheric Systems Div., reported at

found them no better than the best high-frequency transistors for this application. Marshall says he anticipates improvement, however, at the conclusion of their chromatograph research or before a more advanced device. Sustained beta response was noted in the later of two field-effect transistors made by Sheene. The latter one, which had smaller geometry, was found to be less sensitive.

Marshall contends that a complete threshold circuit, including insulation resistance, noise and current gain, becomes feasible, provided it would be superior to the present radiation environment in either bipolar or unipolar field-effect devices. Until such a review is possible, he suggests the isolated threshold circuit for applications requiring equipment operation in the space environment.

The test conducted by the group here primarily used the Hughes Research Lab. Electron Accelerator (see related column) to expose transistors up to 10¹² Roentgens. Some damage and permanent often work has been done at Goddard.

To obtain gamma rays from the form, a neutron target is situated at the end of the tube, and accelerated electrons striking it are converted to gamma rays by the so-called Bethe-Bloemberg (fission) effect.

The insulated diodes are situated in a 2-in. dia circular aperture of a copper box.

About 1 ft high and 2 ft long, the box shields experimental cargo units from electron-beam radiation that accompanies the radiation. A shielded motor follower feeds the mounting instrumentation.

The Hughes basic proton pulse width duration from 600 nanoseconds to over 10 microseconds, but for the present test it took a pulse length between 0.25 to 5 microseconds. Reaccelerating leads to an energy spread from about 5 to 6 mev, somewhat wider energies than a linear accelerator. This beam setup, however, allows a "reasonably good simulation of the gamma spectrum of a nuclear explosion," according to Hughes. Maximum rates from reaccelerating are 10 to 10² Roentgens/sec, but may go up to 10³. Roentgens/sec are produced if electrons are used directly.

This is future interpretation of transient radiation effects on microelectronic circuit.

• Getting better statistical can be testing wave devices from a greater variety of ionizing sources.

• Examining field effect devices fabricated integrally to semiconductor substrates.

• Testing more threshold-controlled gate turn-off devices.

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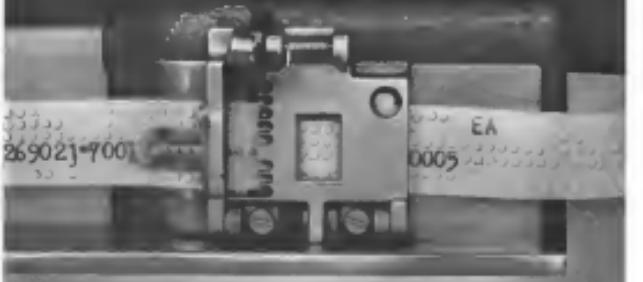
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ALCOA
ROME CABLE
DIVISION

START → RELEASE PULSE STOP

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**the IBM in your office
can order parts from Airwork . . .**

just as this airline is doing. Orders are filled one week later, the part number mistakes are eliminated, the repeat purchase orders are efficient; you receive packing slips and order status data is pushed hard or tape form so your IBM equipment can record receipt of the part, automatically follow up back orders, short, billing details and give you an up-to-date metric parts availability report. It eliminates the need for a lead copy

service, can even prepare the check automatically.

Airwork is the first major parts supplier to offer complete tie-in equipment to handle orders issued conforming to Air Transport Association Integrated Data Processing Specification 200. Airlines are reducing inventories and lead time by ordering from Airwork. Why don't you?

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Airwork
CORPORATION
Midvale, New Jersey



the Aerospace Support Conference Project report. It's all down the hatch and estimated 25% by the 11th orbit for the three flights. Board an earlier shuttle flight, Gherardi indicates the trouble is with heating position. He concludes that performance must be improved by a factor of 5% in terms of life and power-to-weight-ratio ratio before each thermal insulation panels will be suitable for most space applications.

■ **Aerospace Contractors Selected**: Gherardi also announced all of its research and development on its revised guidance systems at the NASA Marshall Center, Huntsville, Ala. The revised guidance activity will be restored at new Aerospace Guidance Management Technology Center at Rollins Research, Huntsville, Ala.

■ **Fast-Fire**: Rudy Lano-Rabe Inter which fires at rate of one pulse per second with output power of two watts per pulse, a new communication available from Micro Optics, Inc., 19 Brighton Ave., Boston, Mass. Configuration claim is it is the fastest firing laser on the market.

■ **Automatic Voice Reports Minimizes Trouble**: When a failure occurs during automatic checkout in an automated Measurement JCIM site, a red light flashes on the console of a branch control center in West Virginia operations who calls the fault site and receives a voice report from a type sensor which describes nature of the trouble. The device, known as remote intelligent visual display (VRIS) produced by Northrup's Northern Div., is modification of the voice interactive priority system (VIPS) which computer developed for use on the B-52 to tell the pilot what one of 10 potentially hazardous conditions control. The Minnesota VRIS contains 70 typed messages. The appropriate message is triggered by the particular sensor or combination of sensors which detect the substance.

■ **USAF To Test Lasers In Vacuum-Assisted Systems**: The test will test laser characteristics under space conditions in a 31 ft. long, 24 ft. dia. vacuum chamber recently completed at Wright-Patterson AFB, Ohio. Chamber contains five viewing ports at 30 in. intervals along top of the chamber. ASD currently is funding about \$8 million in laser technology, primarily through the Air Force and National Laboratories.

■ **\$4.8 million for 30 fundamental analysis to develop laser materials and review progress**: An extensive demonstration of coherent optical radiation.

■ **\$2.75 million for 45 research projects**

involved developing different types and configurations of a number of different laser devices, including the development of modulation and demodulation circuitry.

■ **\$1.75 million for progress to apply lasers to military applications such as communications, radar, navigation and guidance.**

■ Auto-Checkout Equipment Pays Off

Use of automated checkout equipment and other special tools of aircraft and missile contractors has reduced significantly the logistics load in slinging checkout equipment onto missiles, according to report issued at recent International Aerospace Support Conference in Washington. Howard J. Avell, Jr., himself, of Armstrong Div., and first 30% of the LARS has already brought savings on components removed from F-106 D/F aircraft using manual check-out equipment, was found to be in great need of checkout when the aircraft were reprogrammed to 10% for a serial. LARS, which is used on the F-105B which was supported with automatic checkout equipment. Field data collected from two different Air Force F-104 squadrons, one using automated check-out equipment, the other manual, revealed roughly twice as many savings from pilots on performance of

flight control system from the manual which had annual costs, Avell reported.

■ **Col Lowell Eaton Nominated Field Cdr Arthur C. Lovell**, who headed Bureau of Naval Weapons program in incorporate technologies in its avionics equipment designs has retired from the Marine Corps to become president of aerospace contractor, General Marine Corp., St. Louis, Mo. Other principals include Edward Behn, Robert J. Narous and Philip Ferguson, formerly employed at Fairchild Spaceelectronics Div. Nas has intends initially to specialize in microsystems for special purpose computers, according to Lovell.

■ **Signed as the Detired Line-Major** numerous contracts recently announced include the following:

■ **Bendix Electronics Division, Teledyne, Inc., Cleveland, Ohio**, has signed a contract for \$100 million and F-100 aircraft under a \$9-million contract from National Aeronautics and Space Administration's Marshall Space Flight Center. Bendix is supplier of the main equipment for the Saturn I舞台.

■ **Ungarson Electronics Corp., Monacaeville, Pa.**, will investigate electrochemical systems suitable for high energy batteries under \$100,000 award



Microcircuit Device Provides 1:1 Scale

Vertical precision microcircuit layout technique for patterning ultrathin network resist on glass is sufficiently accurate to provide 1:1 scale for many applications without further photo reduction or enlargement to accommodate. Glass plate covered with dark resist is mounted on suitable backlit work surface with edge marked as 0.5-degree angle to facilitate alignment to within 0.0001 in., with line width held to 0.00001 in. over 20-inch long parts, according to manufacturer, Viasol Products Co., 312 Central Ave., Lynwood, Calif. Technique is being used by number of defense manufacturers, including Bendix International Business Machines Corp., Hercules Powder, Pratt & Whitney Aircraft, Raytheon and Sylvania. Manufacturers will hold seminar at Lynx plant, Sept. 9-11, to demonstrate the technique to interested companies.

CLASSIC JOBS OF MEASUREMENT

PERFORMED BY ELECTRO INSTRUMENTS



A Forecast by
Dr. Walter East
President, Electro Instruments, Inc.

"You know it, we'll find a way to measure it. Even if their spirit, even if it has been made to die in the way of expansion, there's still a way."

It was with a measuring heart that the company's founder, Dr. Walter East, the original Shopping Center Digital Voltmeter, was the first to substitute electronically driven switches for mechanical and electrical contacts. This single move proved itself an ideal marketplace for speedier, more accurate, more reliable measurement—with useful applications in powerplants, aircraft, and space.

Since that time we have measured 20 other electronics. First.

The next major signs of relating many older measuring systems. But, more important, they have extended the areas in which our measurements and our systems can be used.

The end result for which industry employs measurement in accuracy... is its precision, time, materials, and money. Looking through these "use" categories, I can see across a number of outstanding examples of economies and improvements. Electro Instruments.

I thought we might possibly present these to industrial engineers, execs, managers, and executives, as ideas they might consider for their own use.

Many readers, I suppose, will have individual measuring problems quite different from those cited in the examples. But, if you have your own needs are worth exploring. "You know it, we'll find a way to measure it!"



Electro Instruments' solid state Digital Multimeter beats previous speed, higher reliability to many jobs of measurement, and at a lower investment.

Telescopng a job that once required 1000 ft of wire now takes one application in no more time. Yet a man employing an Electro Instrument Solid State Multimeter accomplished part of this task in one of America's major aerospace companies.

What was needed was the testing of printed circuit boards (each of 1000 pads and 1000 wires) to determine if each pad gives 10 separate tests for quality.

It took an experienced electronics technician and manager 25 to 40 minutes to do this manually.

In the interest of speeding up this tedious job, experiments with an automatic electronic test system were made. The original solution proved to be a punched tape system—described, incidentally, by one of the company's engineers as "the most primitive of all." An Electro Instruments Solid State Multimeter employed at a key position.

Each of the 1000 pads are now given the 30 tests required. The time saved also—will result in being ahead of the game or a button! (*Name on request)



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EUROPE INTERNATIONAL, 1010, ANAPOLIS, MARYLAND • PARTRIDGE LEROUET, 242 GLACIER, CALIFORNIA



Vertical Displays Have No Moving Parts

Indirect vertical display indicators with no moving parts will be built by Lee Siegel's Industrial Electronics contract from Air Force, Navy and National Aerospace and Space Administration totaling \$100,000. New type displays offer faster response, use less power and are expected to be more reliable and reliable. Under USAF contract, Lee Siegel Instrument Div. will build space vehicle indicator to compute amounts of liquid oxygen in space shuttle tanks with oxygen and fuel used to compute planned mission of orbiter. Navy contract calls for three engine performance indicators to display exhaust gas temperature, fuel flow rate and engine rpm. National Aerospace and Space Administration will get four instruments designed to operate from digital computer and display speeded flight and engine data.

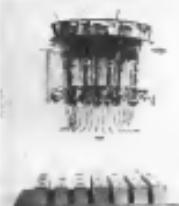
Under NASA's Lewis Research Center • Radio Corp. of America will conduct program definition study to design communications control center for satellite communications satellite under award by Army Strategic Communications Agency. Center to be scheduled initially, says among many general terminals.

• The Marconi Co., Ft. Wayne Ind., will build AN/FMRC-9 communication circuits sets for use in USAF Lockheed C-141 transport aircraft under \$1.7 million contract from Aerospace Materials Agency. Transmitter set to be designed to operate from 28 vdc.

• General Precision Aerospace, Kenton Div., Latrobe, Pa., has received additional funding for total of \$2.7 million, for development and production of airborne computer used in the Navy/North American A-5C (AJ3). • Schenck Electric Products Inc. will develop JH and UH antennas capable of withstanding nuclear blast under S-490,650 contract from Rome Air Development Center. Work will be performed at Waltham, Mass.

NEW AVIONIC PRODUCTS

• Seagov methods say tube developed for use in airborne communications equipment, will permit multiple transmissions displayed on a 10 x 12 in.



metrelographic tube freq. Telec, which contains 21 in. long has 1-16 amplitude variable and variable 1-17 phase. Manufacturer Schenck Electric Products Inc. Electron Tech Div., Schenectady, N.Y.

• Shelduba digital transmitters, capable of performing logic functions at rates above 10 mc, include (in addition to direction find) logic pulse shaping, drive driver and double switcher, a



NAND, AND and OR gate a use that is both a logic multiplier and an independent 1/2/3/3/3 AND gate. Available as a bipolar digital data series with 10 100-1,000 microsecond in two units. Each module measures 0.6 x 0.5 x 0.05 in. and is designed for operation over ambient temperature

range of -69°C to 129°C. Shambler-Vans, Inc., 2384 Walnut St., Garland, Texas.

High-speed photometers. Model 417, has a rise time of only 20 millisecond at one microampere; with no drift caused at less than 1% in eight hours. Instantaneous operating



range is from 10^{-10} amp. full scale to 30 microamps. Accuracy is quoted at $\pm 5\%$ by the company. Manufacturer: Keithley Instruments, 12401 Euclid Ave., Cleveland 6, Ohio.

- Ultra-high-speed pulsed light source, Model SUV-1, for use in transient photoelectron, photoionization experiments has application to research in organic and semiconductor material lifetimes. Instrument contains a Kerr cell pulser which generates ultrafast pulse shapes from a flash lamp whose output整形器 and triggering are in the nanosecond time range. One

available, polar shape is a transversal function for semiconductor testing. Another is a 500 wavelength path which can be changed at its pole elements with a full range of low loss S-waveguides upon command. Optical systems are available either for narrow band operation from 842 to 0.7 microns or for wideband use from 0.12 to 1.2 microns. Manchester Electro-Optical Instruments, Inc., 922 South Main Ave., Menlovia, Calif.

- *Musotoma annulata*, Model 0755, in hermetically sealed zinc capsules 0.955m in the recording hole and measures 3.6 µ, long including tentacles.



Instrument, which can function as position, null or metering indicator, is available with sensitivities as low as 10 microamps. Manufacturer: The Trilect Electronic Instrument Co., Bedford, 12480.

* Percentage spectrum analysis. Mode SPA-12 covers band from 10 sec. to 64 sec. (func.) in seven bands, with rated maximum sensitivity of at least



near 100 d.p.s. for the 14-720 range and of near 90 d.p.s. up to 144 g. Testing d.p.s. is separate from the test of viscosity. The 15% with integral crystal-controlled standard for higher viscosity measurements. The Singer Co., 415 Prudential St., Bridgeport, Conn.

permits operation of up to eight separate modulations from single functions with output resolution of 40 digits according to manufacturer. Gain is flat over the 2-12 kc band. Dimensions 9 x 11 x 15 in. dry weight 5 lb and consumes 15 w. Manufactured by Tek Electronics Inc., 1600 Bunker Road, Wilson, Conn.

- Microspacer silicon transistors, Type 2N2784, with typical total switching time of 12 microseconds in substrate contact applications, provides a gain



bandwidth product of more than 1 giga-
hertz. Transistor, which uses new
three-stage germanium configuration, has
a typical beta value of 70 at 5 mA
according to manufacturer. Germanium-to-germanium bonding is said to eliminate
any electromigration problem. Production
process follows. Manufacturer: SGS
Micro-Electronics Products, Inc., 100 Sykes
Road, Woburn, Mass.



Light-weight X-Band Tubes Introduced

New travel training units will, called *annual travel units*, have 20% fewer figure hours (non-continuous permanent support) (PMSC). People lost less than half as much because, in theory, shoulder support was given more frequently to others during one trip or one, actually, shorter duration. Gertud Bielek has introduced new levels of travelling route rates with five levels appearing in Scotland regions, with more figures in less a 5-9% and a single case 6-8%. The budgetary limiting principle rule will be applied to Guard routes and later by willmexxx travelling route rates in the 12-49 age group. I had Guard Electro units.



SST
and **SUNDSTRAND**

A NATURAL COMBINATION, when you consider Bendixen's capability to meet the technical and economic requirements for constant speed drives in aerospace transportation.

Through experience accumulated during the high mark performance of such key military aircraft as the B-58 and F-106, Sundstrand Aviation has compiled data on thermal control

intensities at high temperature operation. Concurrently, considerable information has been tabulated during in-house environmental testing of the secondary power generating sys-

for the KB-20 air valve?

Strandstrand Aviation has provided constant speed drives for most of the major commercial jetliners spanning the globe today. This includes the Boeing 707, Douglas DC-8, Boeing 720B's, in addition to the new Sud Caravelle Super II, Boeing 727, and the forthcoming Fokker F-28.

Now Sandstrand, with its extensive background experience and advanced technology, is already working to meet the challenges of tomorrow's commercial jetliner—the SST.

SUMMARY AND THE WORKERS' LEADING SUPPLIER OF CONSTANT SPEED DRIVES



SUNDSTRAND AVIATION
DIVISION OF SUNDSTRAND CORPORATION, RODDORFORD, ILLINOIS
Facilities in: Pacific, Illinois; Denver, Colorado—Sales Office in Atlanta, Texas, Illinois,
Cincinnati, Dayton, Ohio; Wichita City, Wichita, Kansas; Minneapolis, Minneapolis, Minnesota; Washington, D.C.—Engineering
Offices in Paris, France; Stockholm, Sweden.



Checkout procedures on a newly manufactured space vehicle—its every component, subsystem and finally, complete system—have recently been a manual task. The complete performance of each item was recorded, then either processed and analyzed using entirely manual techniques, or run through computers, translated into digital language, and then manually interpreted and compared with predetermined optimum standards. Two to three weeks often elapsed before final approval could be given.

With the Lockheed-developed AUTO-CHEK system—Automatic Data Recording and Processing Equipment—checkout time has been cut to a few days. The key to this time and labor saving system is simple. A "filter" device has been

LOOK AT LOCKHEED... AS A CAREER. Consider Lockheed's leadership in space technology. Evaluate its accomplishments—such as the Polaris missile and the Agency vehicle's superb performance records. Examine its outstanding advantages—location, advancement policies, creative climate, opportunity for recognition.

The auto-filter function that gives you a more complete look at Lockheed. Address: Research & Development Staff, Dept. M-60A, P.O. Box 584, Sunnyvale, California. Lockheed is an equal opportunity employer.

SCIENTISTS & ENGINEERS: In addition to portions relating to Automatic Checkout, such as electronic engineers specializing in digital circuitry and logical designs, who represent openings next for specialists in: Laser research • Bio-aerodynamics • Guidance and control • Operations Research • Trajectory analysis • Gas dynamics • Orbit thermodynamics • Chemistry and nuclear propulsion.

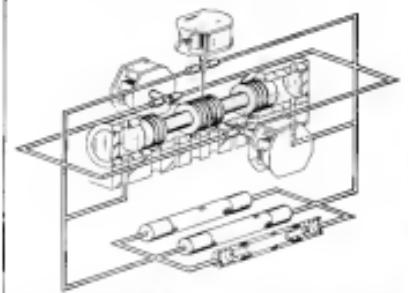
LOCKHEED
MISSILE & SPACE COMPANY
A United Division of Lockheed Aircraft Corporation
Sunnyvale, Palo Alto, Van Nuys, Santa Cruz,
Santa Maria, California • Coco Channel,
Route 2 • Huntsville, Alabama • Hawaii

LOOK AT LOCKHEED... IN AUTOMATIC CHECKOUT

Reducing data reduction



EQUIPMENT



SCHEMATIC OF MAJORITY valve servos developed by Martin Servosystems, Inc., East Aurora, N. Y. Schematic shows three-filter configuration and input reflected first stage of feedback hydraulic amplifier (omitted). In normal operation, these should operate in parallel.

High Reliability Servovalve Design Has Parallel First-Stage Channels

Magnitude rating servos, developed by Martin Servosystems, Inc., East Aurora, N. Y., is designed to provide high reliability demanded for manned space flight and eliminate need the dual-channel feature in redundant hydraulic systems. The magnitude-rating servos use a two-channel hydraulics design with two parallel first-stage channels. Majority voting concept is based on the extensive overpowering of a single failed channel by the remaining two channels. The servos, which is packaged in a single unit, provides the same order of reliability as a completely redundant system with no inherent time lag involved in switching from one system to the other, according to Moog.

Normal Operation

During normal operation, the three channels of the first stage operate in parallel at the same rate. During a single, second-stage spool, which routes hydraulic fluid to the driven element. Either an active or passive failure in any one of the three first-stage channels would result in the malfunctioning channel being bypassed by the others.

In the event of a single channel failure, both have shown that one-and-a-half operators can be maintained. Primary degradation is first pass, which fails off in the fail safe or a region of

about 13% of full signal. Within this region, flow goes to reduced or 67% of normal. Outside this region, flow goes to normal. Thus, in event of single-channel failure, flow can operate within normal response time, according to Moog engineers. Magnitude of magnitude rating servos is about 1000 ft-lb, approximately 15% of the full signal in active channel and does not materially affect control operation. Unit would still operate if two of three channels failed but at reduced efficiency, depending on type of failure.

Brute Force Techniques

Reliability in the single second stage is increased by what Moog calls a brute force technique to overcome pumping due to pressure fluctuations in the hydraulic lines. Speed has been made considerably larger (approximately 0.5 in./dia.) than standard speed (approximately 0.15 in./dia.) so that higher driving forces are available to break loose contamination at mating edges or adjacent to the sliding surfaces.

It is felt that driving forces of the order of 400 lb. (1,000 psi system), when applied to an extremely hard spot with sharp cutting edges, should be sufficient to cut through any misconceived contamination.

Filiter protection, suggested by



Motivation

Martin Denver knows the importance of having individuals at the right career crossroads. It is important that factors that affect the qualified personnel and a team built a dynamic force through the development process and procedures that make these factors a standard. Motivation is challenging problems - progressive challenges - excellent working conditions - rewarding compensation - opportunity for personal and professional success.

You will gain considerable opportunity for professional advancement in Martin's TEAM II program. If just one of any of the following - or related - fields,

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- CONTROL SYSTEMS
- AEROTHERMODYNAMICS
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- Test and Application Engineers;
- Circuit Designers and packaging specialists familiar with airborne applications and other professionals whose experience qualifies them to move up to the challenging and rewarding work of precision guidance/navigation systems development.

Our work emphasizes all the test include Guidance Systems for Guidance, Gyroscopic plus other major proprietary programs in the navigation field. Key assignments are now available in:

SYSTEM DATA ANALYSTS

Experience with large scale digital computers and data reduction techniques. Knowledge of curve fitting techniques, numerical analysis, and statistical analysis is necessary. Knowledge of inertial guidance systems and error sources desirable.

Will develop automated data reduction techniques, starting with the most restricted result of the system, flight trajectory profiles, etc., and continuing through detailed programming and analysis of data to provide complete flight testing, sled testing, laboratory evaluation and environmental tests. Will be directly involved with data resulting from R & D flight testing at the Cape.

COMPUTER SYSTEM ENGINEERS

Experience with theory and design of programmable aerospace general purpose computers. Will analyze requirements, conduct design studies, determine performance test criteria, and work on or lead the design improvements and develop new methods for using computers.

SYSTEM OPERATION ANALYSTS

Experience in total weapons systems and the application of inertial guidance to these systems.

Will analyze guidance systems operational requirements from the standpoint of the overall weapons system or space vehicle. Will anticipate mission problems related to the guidance/flight control system and recommend solutions.

SYSTEM ANALYSIS ENGINEERS

Experience in guidance and control analysis, control system optimization, error analysis and error propagation for inertial guidance systems, gyroscopic systems, and/or a systems analysis theorist. Knowledge of advanced calculus, vector analysis, classical mechanics, fluid dynamics, root locus, linear and Laplace transforms highly desirable.

Will analyze error sources in inertial guidance systems and their contribution to system performance. Will conduct system performance studies, start system analysis and solve trajectory problems using analog/digital computers. Will construct mathematical models.

SYSTEM DESIGN ENGINEERS

Experience in guidance and control system design, configuration analysis, system test or evaluation, circuit analysis, and inertial sensors and sensor theory.

Will exercise the state-of-the-art for total application of inertial electrical sensors and manually operated optical sensors for the development of inertial and combined spacecraft. Will conduct preliminary design studies of navigation and control techniques for automated manned and unmanned spacecraft.

SYSTEM INTEGRATION ENGINEERS

Experience in integrating the various components of an inertial guidance system and integration of guidance system with the vehicle. Knowledge of inertial navigation, gyros and accelerometers is required.

Will integrate components into the inertial guidance system and solve problems of interface such as grounding, signal isolation and hardware and digital computer interface.

Other opportunities exist for Systems Test Engineers, Inertial Computer Test Engineers, Inertial Computer Application Engineers, Environmental Test Engineers and Mechanical Design Engineers with backgrounds in Package Design and Analysis, Thermal Design and Analysis and Vibration Analysis. Now, find out just what Honeywell in Florida can offer you. Just send a brief note describing your education, experience and specific area of work interest to: B. A. Kress, 13390 U.S. Highway 19, St. Petersburg, Florida. We promise a prompt reply and probably an invitation to visit our facilities, meet our people and discover for yourself the added advantages of working and living here on Florida's Suncoast.



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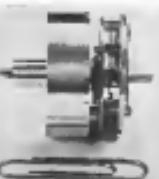
To investigate professional openings in other Honeywell facilities, send resume to P.O. Box 1600, Minneapolis, Minnesota 55402.

NEW AEROSPACE PRODUCTS

Self-Starting Timer

Mechanical timer designed for use in missiles and satellites. Self-starting component permits automatic starting of the timer, the manufacturer says.

The timer, Model 2-456, operates for 36 hr. Modification of the timer

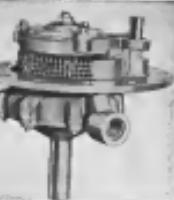


spans allows 100-500 hr operation, according to the manufacturer. Design withstands 20,000 g force in any direction and operates at -57° to +160°F. An adjustment unit to update the timer's 240-hour timer setting is available. Output voltage is 5 v rms and needs can be adjusted to 24 or 48 v dc by reconnection. Exponent range can be varied over a 4 to 1 range. The timer's movement is 5 in. dia. by 4 in. high.

Pitcairn Space and Defense Systems, 300 Robbins Lane, Syosset, L.I., N.Y.

Fuel Booster Pump

Centrifugal fuel booster pump has ten times duty by need from a hydrogen engine. Pump output increases as density decreases depending on the engine load.



It is resistant to constant speed pumps. It has a 690 cc/hr. maximum capacity at 8 rpm. Cost is \$15.50 high and weight 1.6 lb.

Romer Facility Power Equipment Div., Lear Siegler Inc., 241 South Akard Road, Dallas, Ohio.

Hydrogen Bi-Propellant Valve

Model 30X245 Hydrogen bi-propellent valve is designed for use in spacecraft attitude control systems.

The valve consists of a single torque motor driving a balanced nozzle poppet valve.

It is designed for use with UEMET fuel and nitrogen trichloride oxidizer which are mixed separately.

Internal leakage of less than 0.5 cc per day, zero external leakage and a response time of less than 5 millisecond with a maximum input of 30 w are claimed by the manufacturer.

Moog Aerospace Div., East Amherst, N.Y.

Miniature Accelerometer

Type 1045 linear accelerometer can be used on small missiles, stabilized platforms and gyro gimbals in guidance systems.



Unit weighs 1 oz. and occupies 0.6 cu. in. It is hermetically sealed in a stainless steel case with a 5,000-cps piezoelectric output and is available in the 0 to 50 g range.

Honeywell Inc., 2855 Comer St., San Diego, Calif.

Biological Telemetry System

Minature biological telemetry system transmits electroencephalographic, cardiopulmonary and galvanic skin response data via two housing halves and three internal tubes. Unit can be programmed to operate and transmit activity information, according to the manufacturer.

Transmissions at FM/FM at 65-103 mc with a 100-300 range. Relytek Model 334 telemetry system transmits 1.5 x 1.25 x 0.15 in. and weighs 2.3 oz. including the 30hr battery. Unit is presently available with 1, 2 or 3 channel outputs.

Honeywell Inc., 5835 Bludeweller St., Cedar City, Utah.

ENGINEERS AND SCIENTISTS

EXPANDING NEW DESIGN EFFORTS CREATE CHALLENGING OPPORTUNITIES FOR TOP FLIGHT SCIENTIFIC AND ENGINEERING PERSONNEL IN THE FOLLOWING AREAS:

SCIENTISTS

Responsible experience in advanced systems research with specialized interest in the areas of communications, solid-state electronics, microelectronics, precision instrumentation, aerodynamics, performance analysis with the spaceman segment, and the development of electronic instruments. You should have knowledge in defining electronic systems and performance in advanced weapon systems studies.

ADVANCED DESIGN ENGINEERS

Responsible experience in advanced systems research in the areas of communications, solid-state electronics, microelectronics, aerodynamics, performance analysis with the spaceman segment, and the development of electronic instruments.

AERODYNAMICS ENGINEERS

Responsible experience in analysis and investigation of aircraft performance, stability and control, and configuration studies.

AIRCRAFT STRUCTURES ENGINEERS

Responsible experience with analysis of aircraft structures with respect to strength, weight, loads and fatigue analysis.

AIRCRAFT DESIGN ENGINEERS

Specialized experience in the investigation and performance of aircraft components and subsystems, aircraft systems, and aircraft systems analysis. Also must be capable of performing manual and computer analysis of interconnected aircraft and subsystems, and capable of writing a program oriented report. Heavy experience required. Prefer R&D or R&E degree.

AIRBORNE RELAY ENGINEERS: experience design with experience in the design and development of relay systems for aircraft and space applications. Required are solid systems design and test skills, also solid design. Knowledge of simple logic switching and current drive relay necessary.

ALSO OPENINGS FOR:

FLIGHT TEST ENGINEERS

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ENGINEERS

NUCLEAR ENGINEERS

For further information, contact Mr. Frank J. Murphy, Manager, Manpower Planning Group, One Westgate, P.O. Box 1000, Atlanta, Georgia 30301.

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INTERNATIONAL AIR TRANSPORT ISSUE

October 7, 1963

To meet the information challenge created by the international character of aviation, AVIATION WEEK & SPACE TECHNOLOGY publishes each year an issue devoted to international air transport progress. This issue is received with such enthusiastic response that it will again be greatly expanded to provide the most comprehensive analysis and forecast of the air transport industry and its technical developments.

Publishing date is October 7, 1963, timed to coincide with the annual general meeting of the International Air Transport Association (IATA) in Rome. Copies of the issue will be flown to Rome for distribution at the opening plenary session to airline presidents, IATA delegates and other world aviation leaders.

Key themes will be the current problems in international air transport including bilateral agreements, rates and tariffs, flight equipment, passenger, mail and cargo traffic, air traffic control, the capacity issue, exchange of international routes. Other subjects essential in a full analysis of the airline industry will be stressed including trends in supersonic transport development, military transport operation, survey of Russian and Communist Bloc airline activity, impact of U.S. international transport policy on world political and industrial relations.

Feature treatment will be given to trends and projected future prospects for traffic growth and development of flight equipment in all major world markets: North and South America, Atlantic, Pacific, Europe, Africa, Middle and Far East. A graphically illustrated, at will also contain specially prepared charts and graphs to show growth and future trends.

This impressive list of topics slated for coverage will involve the world-wide editorial staff of AVIATION WEEK & SPACE TECHNOLOGY. Timeliness of the issue date coupled with AVIATION WEEK'S reputation as the authoritative respected voice of international aviation promise to make it the most important advertising opportunity of the year for your equipment, products and service to the airlines. Identify your role in air transport at a time when attention will be focused on major industry issues.



**Aviation Week
& Space Technology**

A Division of McGraw-Hill Publications 222 West 45th Street New York, N.Y. 10036

MERGERS AND ACQUISITIONS

Littton Industries and General Mills expect them bands of firmness long awaited in principle the sale of General Mills' aerospace research and engineering department in Minneapolis, Minn. for an undisclosed sum of cash. General Mills facility employs about 200 people engaged in R & D work in upper atmospheric physics, meteorology, communications interests, and medical large and medium research.

Consolidated American Services Inc. (CANSAT), Hawthorne, Calif., a supplier of non-destructive testing, missile cleaning, and nuclear decontamination services, has acquired the assets of Participax Management Corp. as a division. More, FMC has a seven-year contract with the Air Force for the operation of its installation at Wake Island. The acquisition was for an undisclosed amount of stock.

Telephone, Inc., Hawthorne, Calif., and Standard Engineering Corp., Gardena, Calif., are planning a merger. The transaction subject to approval of stockholders and the California Commissioner of Corporations, would involve a stock exchange.

Amphenol-Borg Electronics Corp. has sold a substantial minority interest in Daikoku Denki Kogyo Co. K.K., a joint venture company formed in Tokyo to manufacture electronic and electrical components.

Intertronics Radio Workshops, Inc., has sold its Dodge Teletronics Div., maker of ultrahigh frequency TV, to Raytheon-Wels Corp. for an undisclosed sum. The division will continue operations in Michigan City, Ind., in Dodge Teletronics Div., a division of Raytheon.

Aero-Chetline Corp. of New York City has acquired the A-H Enviro Co., of New Canaan, Conn., for \$3.5 million. The Chetline company owned 32,752 shares of formerly owned 6% preferred stock. A-H Enviro Co. manufactures hydraulic load cells for testing instruments, rotatable relay devices and indicating equipment.

Imperial Thermal Systems, Inc., of Isasca Park, Calif., has acquired the Thermal Systems Branch of Advanced Structures, a Div. of Telecomputing

Corp. for an undisclosed amount. The acquisition extends Imperial Thermal Systems' capabilities in the aerospace and military ground support field.

VSI Corp., Pasadena, Calif., has acquired the assets and business of Wintec Inc., Hawthorne, Calif., for an undisclosed cash sum. Wintec manufactures metal shims and related products. The new acquisition will be operated in the Wintec Div. of Melting Magnetic Inc., Vernonville, Mich.

Prestolite Div. of Martin Marietta, a manufacturer of aerospace interests, has been acquired and is being operated as a division of Intermetals Corp. It was acquired in a \$6-million transaction.

International Telephone and Telegraph Corp. has agreed on terms for the acquisition of Carson Electric Co., Los Angeles, Calif. Carson makes plug and receptacle assemblies for industrial, commercial and military-type use. The acquisition is subject to approval by shareholders of Carson and the legal consent of both companies.

IMC Industries, Inc., Memphis, Tenn., has purchased Artesic Electronics Inc., also of Memphis, through a stock exchange.



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For the development of mathematical models and the generation of test criteria utilizing the laboratory's 805 820 digital computer.

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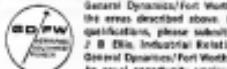
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WHO'S WHERE

(Continued from page 21)

Changes

General Dynamics/Aerospace, Inc. Dr. George C. Gelt, has named the following as chief engineer, aerospace structures and thermodynamics: David J. Peccey, formerly chief Douglas flight mechanics; Paul D. Kremer of microsystems.

A. F. Johnson, public relations manager, Hawker Siddeley Group Limited, London, has been appointed director of sales, Marconi Co.'s Elyton (Md.) Div.

Robert H. Holmes, director of military marketing, Marconi Overseas Corp.

Dr. Richard F. Highland, director of Pasadena University's aerospace science library, has been promoted to professor.

In Robert R. Spangler, director of research and development trials and space activities, Control Motor AC Spark Plug Div., with headquarters in the Hill Segundo (Calif.) Division.

James F. O'Conor, manager, Industrial Div. of Textron, Waltham, Mass., a division of Litton Industries Inc. Electronics, Inc. David K. Hart, assistant director-engineering product manager and design, Research and Design section, Div. of LTV Electronics, Boston, Mass., has been promoted to manager.

Carl M. Seppel, sales manager, Reliance Relays, a division of Reliance Electronics Corp., Costa Mesa, Calif.

Vincent J. Bresette, Inst. Product Development, Dept., Winstan Div. of Thermo-Chemical Corp., Winstan, U.K.

De Philip Lepp, project engineer-Lance Missile Project, Defense Div. of Hydronautics Corp., Covina, Calif.

Charles W. Gobin, manager of agency, industrial and military sales-Pacific Division, Trans World Airlines, Inc., with offices in Los Angeles, Calif.

Warren E. Koenig, Associate, appointed marketing supervisor to KLM Royal Dutch Airlines in the U.S. Prior to joining the airline company, Mr. Koenig was first vice-president-marketing of the St. Louis-based Airco Systems, Inc.

Dr. Gerald H. Rosen, senior research physicist, Department of Electronics and Electrical Engineering, National Research Institute, Ottawa, Ont.

Dr. Samuel H. Bond, Inst. Reliability and Statistics Dept., Engineering Div., San Francisco (Calif.) Operations of Aerospace Corp. Also Frank Kalika, director of systems engineering, Mobile Mid-Range Ballistic Missile Program (MMRBM), San Francisco Operations.

J. E. Thompson, chief of design and reliability engineer, Lear Jet Corp., Wichita.

Donald F. Stevens, director, Aviation Engineering Div., Aerospace Electronics Div., Phoenix, Arizona, deceased.

Donald L. Harbach, manager, Western Regional Office of Polaris Corp.'s Aerospace Div., Novato, Calif., supervising Staff C. Glavich, now vice-project director of program in Aerospace's Research Lab. Also, Carl Glavich, formerly spokesman James A. Trotter, manager of Polar Probes Program, Enduro Reprogr. Office, Washington, D.C., Randolph P. Cline, assistant manager, Malvern's Regional Office, Dayton, Ohio.

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